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PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

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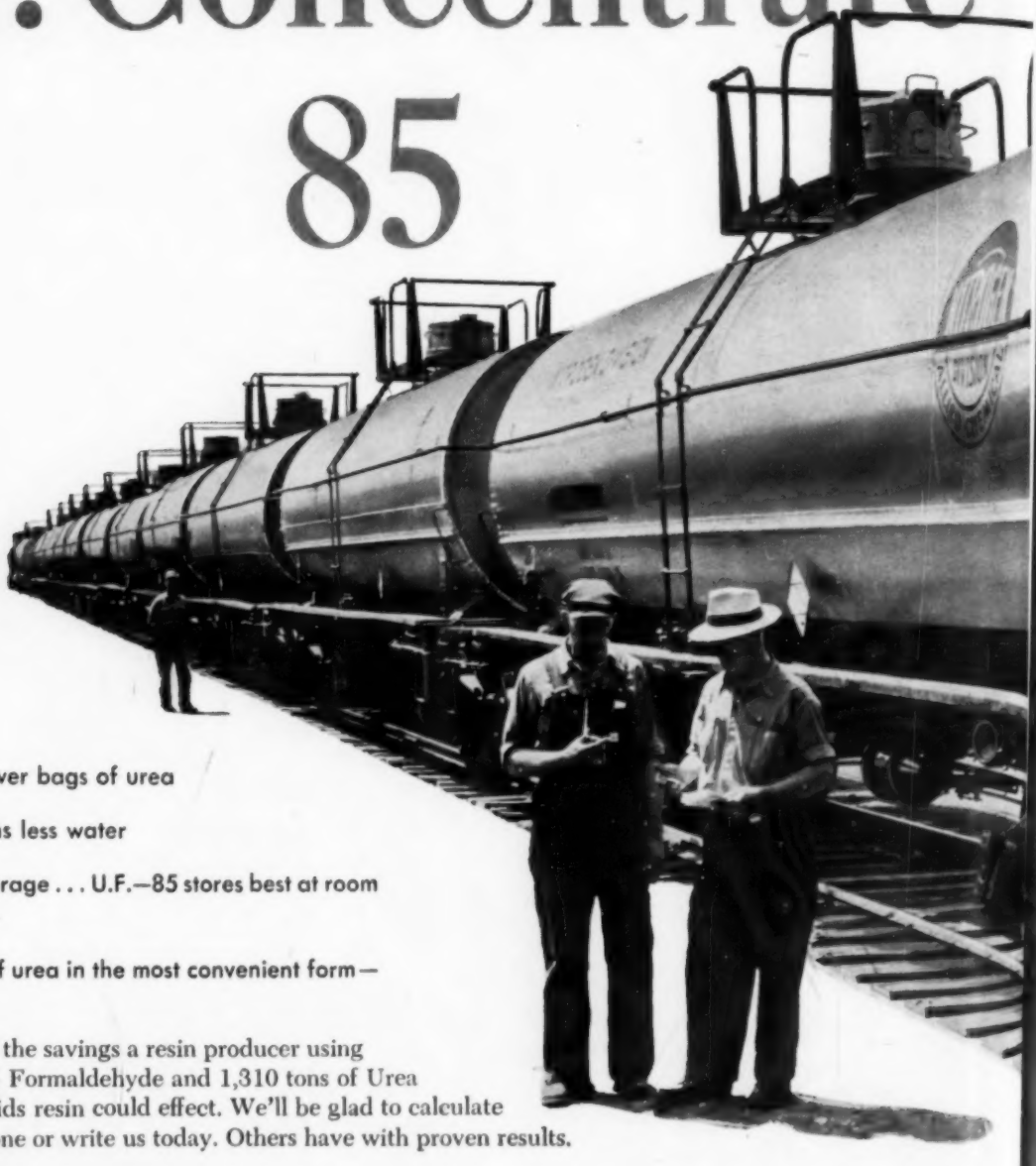

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Editorial and Executive Offices at 386 Fourth Avenue, New York 16, N. Y. Subscriptions in United States and possessions and Canada $4.0 per y
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THE MAGAZINE OF APPLIED ENGINEERING

PLASTICS TECHNOLOGY

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Published monthly by

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386 Fourth Avenue, New York 16, N. Y.

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Letters to the Editor

Mold for Pencil Holder?

Dear Sir:

We are attempting to locate a plastics molding firm that has a mold to make a simple, inexpensive pencil holder that will fit on calendars.

If you know any firm that has this, especially in the Chicago area, will you kindly advise?

S. J. Lipinsky
Cardinal Creations
Chicago, Ill

(Do any of our readers know of such a molding firm? All replies will be transmitted to Mr. Lipinsky.—Editor)

• • •

Comments on Market Price List

Dear Sir:

I appreciate receiving your magazine each month, and each issue seems better than the last. While some scientific articles are "over my head," there is always at least one that clearly and completely describes a subject of current interest.

The current series on stabilizers (*Nov. & Dec. 1955*) is very informative as I can find very little printed literature on the subject, written in understandable language.

I have one suggestion about your listings of "Current Market Prices." You might indicate in the minimum/maximum price per pound or gallon what these extremes are. For example, a footnote might say the minimum container is a one-gallon can, 10-pound carton, etc., and maximum is a railway tank of X capacity. Similarly, resin powders are packed in 50-pound paper sacks, etc.

Another point of confusion about prices is that some are f.o.b. producing plant, while others are prepaid to destination. In these days of close figuring, even the product designers at the engineering level find it advisable to consider comparative costs.

Frank Pray
Technicraft Co.
Boston, Mass.

(We appreciate your comments on the price listing. When originally setting up the listing, we had planned to indicate the quantities for each material and their prices. Since container sizes vary between companies and products, we found that explanatory footnotes would be needed for almost every quotation. This problem did not apply only to maximum and minimum quantities, but also to the intermediate sizes. Indicating container sizes by any means would mean more than tripling the length of the price listing.

Another difficulty stems from the impossibility of keeping our listing completely up-to-date. Some price changes usually are received immediately after we close the printing forms for an issue, and these new prices often are already in effect, thus making the printed prices outmoded.

These two problems resulted in our use of the boxed note leading off the price listing. This note states that we do not guarantee the prices, and tells users to obtain spot prices from the individual suppliers.

This, in essence, explains some of the factors in the price listing. The format of the listing is not definite, however, and we will be ready to make any changes or modifications requested by a majority of our readers.—Editor)

• • •

Flame-Spraying Equipment

Dear Sir:

We would like to contact a manufacturer of equipment for the application of plastics to metal by the flame-spraying method. Plastics are applied to metal with a specially-designed spray gun where the plastic material is passing a flame zone shortly before being sprayed on the metal. The plastic hits the metal at fusing temperatures.

We would like to ask for your cooperation in this case.

H. deHahn, Devel. Engineer,
Dominion Rubber Co., Ltd.,
Montreal, P. Q., Canada

(Equipment for flame-spraying is made by American Agile Corp., Bedford, Ohio. If our readers can furnish any additional sources of such equipment, they will be forwarded to Mr. deHahn. —Editor).

• • •

Who Makes Hot Stamping Machines?

Dear Sir:

I would like to determine the manufacturer of a small model hot stamping machine, as described on page 624 of your November issue.

John D. Tomlinson, Chem. Engineer
Minnesota Mining & Mfg. Co.,
St. Paul, Minn.

(The description in reference was for a typical small model hot stamping unit. A list of manufacturers of these units has been sent to the inquirer.—Editor)

• • •

Prices for Market Listing

Dear Sir:

We have found your magazine to be very interesting and informative, particularly the market price listing of the various manufacturers of raw materials.

Since we are one of the leading manufacturers of pigment dispersions for both coatings and plastics, we feel that our colors for plastics deserve to be listed along with those of the other manufacturers. These colors consist of our standard Vinyl Extrusion Chips for pigmenting granular compounds, our Plastic Powders for Vinylite dry blend compounds, and our Resin Plasticizer Pastes for pigmenting plastisols and organosols. A brochure describing these three colors in more detail is enclosed, together with our latest price bulletin for the three lines.

D. F. Farnsworth
R-B-H Dispersions, Div.
of Interchemical Corp.
Bound Brook, N. J.

(We are happy to include these colors in our price listing since the more comprehensive such a listing is, the more valuable to our readers. This letter is being printed to remind all companies not already represented in the "Current Market Prices" to submit price quotations on their products for inclusion in the listing, and to inform us of future price changes or additions.—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation, and address.

Letters requesting information on technical or engineering problems will be printed to elicit replies by the readers, either directly or through these columns. Upon request the identities of such "problem" letters will not be divulged.

—The Editor

Good medicine for vinyl stabilization problems!

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For better vinyl stabilization at no additional cost... greater thermal protection...improved production quality and efficiency—investigate the THERMOLITE family, M & T's complete line of organo-tin stabilizers. More and more producers of vinyl products are switching to THERMOLITE stabilizer blends for their particular formulations and getting more working material per dollar invested in stabilizer.

TONIC FOR VINYL TILES

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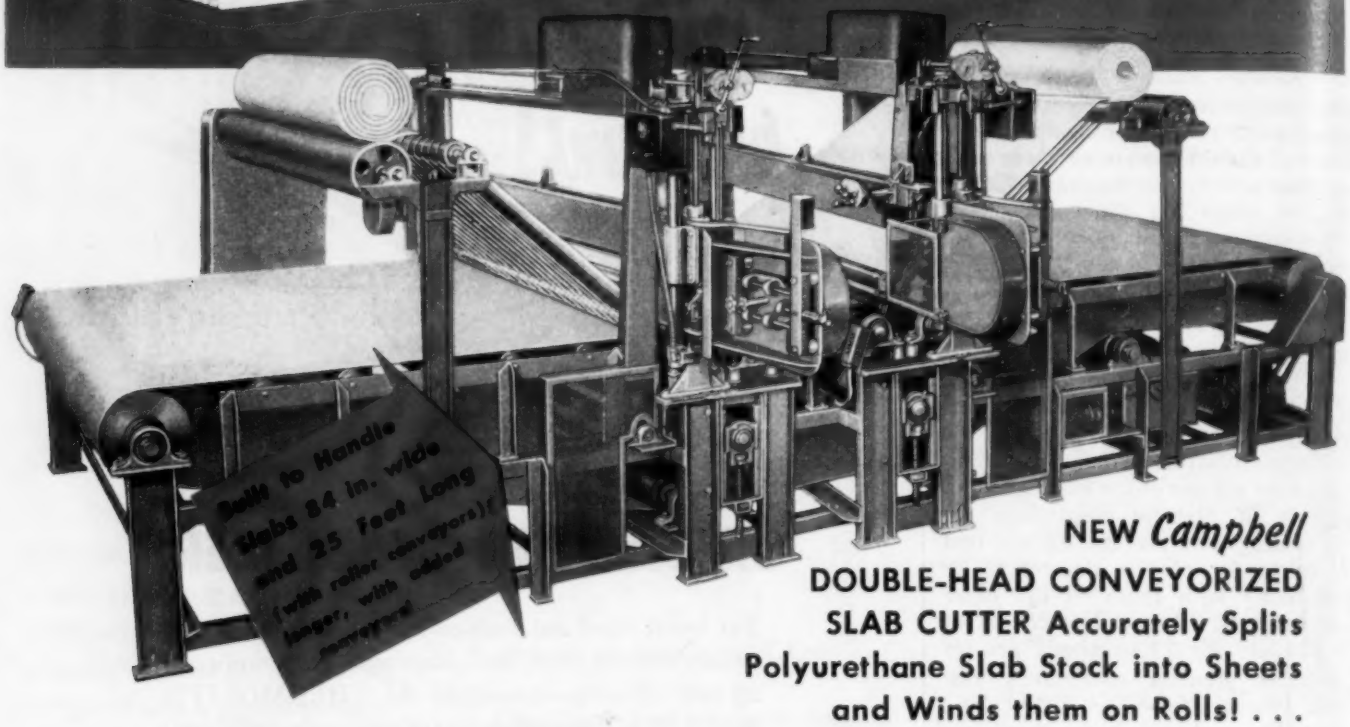

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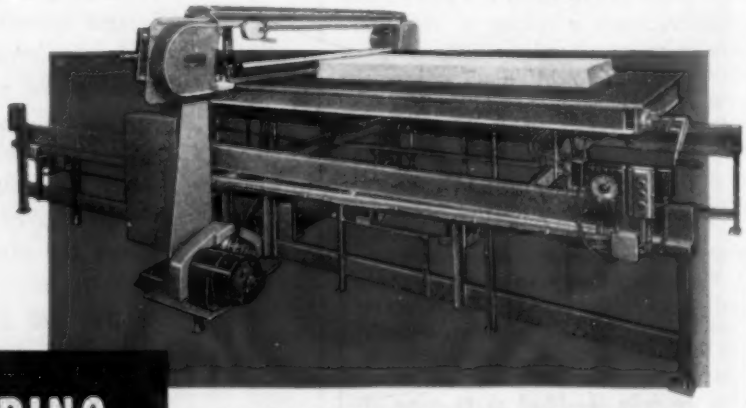

NEW FEATURE OF THIS EQUIPMENT

Machine features new mechanism* which automatically raises and lowers table to clear the cutting blade on the backward movement of table and stock, and indexes to required thickness on the forward movement. Table sizes of machine: 45" x 64"; 45" x 84"; 64" x 84"; 64" x 96"; and 84" x 110".

Write, wire or call for details.

* *Standard equipment on 84" x 110" size*

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NEWS in BRIEF

Chemical construction during 1956-57 will cost an estimated $1.6-billion, according to a recent survey by MCA. The total for construction projects by the chemical industry that were either completed last year, are still under way, or are definitely committed for completion by the end of next year reaches a cost of $2.3-billion.

Plastic tools and dies permit savings of up to a quarter-million dollars in a single phase of automotive production by reducing the number of required tooling operations, says F. L. Bogart, Marblette Corp. He predicted the development this year of non-toxic hardeners for epoxies, a room-temperature curing epoxy foam, a stable phenolic board that can be machined with standard woodworking tools, non-sagging troweling and splining resins, and metal-filled epoxies for casting applications.

Vinyl foam usage is expected to reach an annual total of 50-million pounds by 1960, according to E. H. Schwencke, president of Elastomer Chemical Corp. (see guest editorial, page 94). At present, a daily total of 10,000 pounds of vinyl foam in sheet stock is being produced by four of the 25 domestic licensees under the Elastomer patents.

Entering the plastics field are two new companies. Devoe & Reynolds' Jones-Dabney Resins & Chemicals Div. will be a basic supplier of epoxy resins, and has established a new technical service lab. Production is under way in its new Berkeley, Calif., plant by Kennerley-Spratling, Inc., a new firm doing custom molding by compression, transfer, and injection.

Company developments announced during the month included the official merger of Niagara Alkali into Hooker Electrochemical, where it will operate as a division; and the joint establishment by Metal & Thermit and United Chromium of Canada of a new Canadian company to carry on activities of both parent firms in that country.

Company expansions continue to come thick and fast. A $15-million titanium dioxide plant has been opened by American Cyanamid in Savannah, Ga. Bassons Industries purchased plant space in Yonkers, N. Y. A new vinyl esters unit goes on stream this month at Carbide & Carbon Chemicals' Niagara Falls, N. Y., plant. Dow Chemical is building a new synthetic latex plant at Pittsburg, Calif. The erection of a new Orlon acrylic fiber plant at Waynesboro, Va., is under study by Du Pont. A new PVC plant is being built by Eleonora Chemical in Passaic, N. J. A new engineering development center will be established this year by Lummus in Newark, N. J. Mayon Plastics has moved into a larger plant in Hopkins, Minn. Metal & Thermit plans a new titanium ore plant at Montpelier, Va. Construction of a new adipic acid plant is under way by Monsanto at Luling, La. Naugatuck Chemical will build a new Kralastic plant at Baton Rouge, La. A tripling of production is expected by Polyplastex United when its new Union, N. J., plant begins operating next month. An expansion of its equipment, products, and services has been completed by Portco's paper and plastic division, Vancouver, Wash.

New Materials that merit attention (see pages 120-21): modified epoxy resin; metal-plastic mold material; methyl-vinyl ketone; two phenolic molding compounds; two chemical intermediates for resins; three premix polyester resins; and a phthalate plasticizer.

New Equipment worthy of mention (see pages 122-23): three-shaft turret winder; sheet forming machine to make plastic caps for paper containers; plastic threading machine; thermocouple connector systems; and a toggle-type vertical press.

New Products to be noted (see pages 124-25): molded coil windings; styrene pull clips for window shades; PVC-insulated low-voltage cable; caulking gun with polyethylene components; melamine table accessories; inflatable world globe of vinyl; mica-filled epoxy laminates; industrial tote boxes of rubber-styrene; and a troll line length meter with nylon gear train.

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PLASTICS TECHNOLOGY

FEBRUARY, 1956

EDITORIAL: Preventing Confusion in Polyethylenes—II

Continuing the discussion begun last month on how to prevent confusion about the various polyethylenes in the plastics industry and among consumers, it was emphasized that the first step should be the dissemination of comprehensive comparative data on the different types to permit their proper handling and usage.

This program of data dissemination should be pegged to nomenclature distinctions that will permit quick identification of the different types and prevent any possibility of confusion arising in the mind of the user. Unfortunately, this nomenclature problem is quite complex.

•

To reiterate the polyethylene types, we find that the following four varieties will be on the market in the near future:

(1) Conventional or high-pressure.
(2) Low-pressure Ziegler types.
(3) Low-pressure Phillips types.
(4) Copolymers of high- and low-pressure types.

The ideal nomenclature, of course, would have different names for each of the four types, but this ideal is not practical. Since each of the four types is based on ethylene, the "polymethylene" designation being advocated by some firms is not defensible chemically. Mature consideration of the problem shows that there is little or no chance for one-word names that would distinguish between the four types.

The next possible solution is for the adoption of two-word names. Here, among the designations that have been proposed are: high-pressure polyethylene and conventional polyethylene (type 1 only); low-pressure polyethylene (covers types 2 and 3, but does not distinguish between them); ethylene copolymers (type 4 only); linear polyethylene (same comment as for the low-pressure polyethylene); and high-modulus polyethylene (type 3, as distinguished from types 1 and 2).

More designations are constantly being proposed, but are only adding to the confusion that is beginning to surround the polyethylene family

•

It is obvious that the nomenclature problem will require careful consideration. Fortunately, there is a representative body in existence that is equipped to study the nomenclature problem in all its ramifications; ASTM Committee D-20 on Plastics has a Subcommittee X dealing with "Definitions, Nomenclature, and Significance of Tests." This group should be able to handle the problem and come up with a satisfactory solution.

This solution, when derived, must then be implemented. The suppliers will have to adopt and maintain the proper polyethylene designations that can, in turn, lead to industry-wide consistency.

Arthur M. Merrill

Editor

Another new development using

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Rigid sheeting made from Geon can be formed into many shapes. It has high impact strength, high dielectric qualities, cuts easily—reasons why Geon is taking over with new applications every day.

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Plain Talk on Polyethylene*

Linear polyethylene is compared with regular polyethylene and polystyrene in terms of fundamental properties, manufacture, and molding conditions.

W. C. GOGGIN, *Manager*
G. B. THAYER, *Head of Molding Section*
and
G. W. CHENEY, *Head of Extrusion Section*
Plastics Technical Service
Dow Chemical Co., Midland, Mich.

This year, polyethylene suddenly became a family of materials. Several new types have been announced, and considerable effort has taken place to develop these materials. Foremost among the newcomers is a polyethylene produced by an entirely new process. We prefer to call it "linear" polyethylene for reasons which we shall discuss later. We, along with many others, have been actively engaged in the development of both the polyethylene produced by the older, well-known, high pressure process, as well as that produced by the newer, unique process just mentioned.

We would like to discuss our experience with both of these polyethylenes, with particular emphasis on a comparison of these materials. We would like to consider the basic properties of linear versus regular polyethylene. This latter type, for reasons discussed later, we shall call "branched" polyethylene. Second, we would like to discuss the fabrication characteristics and fabrication requirements; and third, particular problems encountered during linear polyethylene development. We will use polystyrene as the reference point, and in each phase of our discussion, we will contrast polystyrene and branched polyethylene with linear polyethylene.

Molecular Structure

Figure 1 shows an artist's conception of a group of molecules of each of the three materials. Polystyrene is an amorphous plastic material existing essentially as a solid at normal temperature. The long, crooked lines are intended to illustrate the long, randomly-arranged molecules as described by high polymer chemists. In its normal state, these molecules do not show any directional characteristics and the product is said to be unoriented.

In the central portion of Figure 1 is a polyethylene made by the older, high pressure process. This process results in long molecules which have a large number of branches or projections extending from the main chain. It is for this reason that we prefer to call this material branched polyethylene to differentiate it from linear polyethylene. For purposes of simplicity, we have taken a few liberties in our art work that the high polymer chemists may find difficult to digest. In this central portion of the figure, there are darkened areas wherein the molecular chains are somewhat more parallel than in other portions. This parallelity permits crystallization to take place and the polyethylene, which normally exists as a highly viscous liquid, has these solid islands of crystallites in it. This is really a simplified description of a highly complex arrangement.

In the bottom portion of Figure 1, linear polyethylene is illustrated. Because of its unusual method of manufacture, this material does not contain molecular branches. The absence of these branches permits more parallelism to exist in the long molecules, resulting in higher crystallinity. Thus, we have a material that is predominantly a solid because of the stiffening effect of

* Based on a paper presented at the eleventh meeting of the New England Section, Society of the Plastics Industry, Inc., Manchester, Vt., Oct. 14, 1955.

William C. Goggin joined Dow in 1936, after receiving a B.S. from Alma College and a B.S. and M.S. in electrical engineering from the University of Michigan. From 1936-39, he did research and development work on new plastic copolymers; was in special products and plastics sales from 1939-43; and formed Dow's new plastics development and technical service organization in 1943. He was technical consultant to the Quartermaster Corps in 1945, investigating the German plastics industry. This work resulted in the book, "German Plastics Practice." His society memberships include SPI, SPE, ACS, and the plastics committee of MCA.

Pincombe Studio

Gordon B. Thayer received a B.S. in mechanical engineering in 1934 from the University of Michigan. He was with General Industries Co. as a tool and design engineer from 1939-41, and joined Dow in 1941 as a group leader in the saran development laboratory. He was appointed to his present position in 1947. He is active in SPE, SPI, and the Rubber & Plastics Division of ASME, in addition to being a member of our Editorial Advisory Board.

Grant W. Cheney joined Dow in 1937, after receiving a B.S. in mechanical engineering from the University of Michigan. He was an engineer in the company's cellulose products department from 1937-48, and joined the plastics technical service staff in 1948.

the higher percentage of crystallites. This will account for differences in performance and stiffness from branched polyethylene.

Fundamental Properties

Figure 2 shows some fundamental properties of these three plastic materials. While wide ranges of properties are available in the case of each plastic material, significant average values have been selected for this purpose.

Plastic materials like polystyrene and polyethylene are produced by a process called polymerization. The monomer, which is the starting point of this process, has a specific molecular weight. As indicated on the chart, this weight is 104 for polystyrene and 28 for polyethylene. These individual monomer molecules are then polymerized as indicated; 500 units for polystyrene, 700 for branched polyethylene, and 2,000 for linear polyethylene. Thus, the lowest molecular weight material of the three is the branched polyethylene, while polystyrene and linear polyethylene are approximately equivalent in molecular weight.

There are other significant differences. Polystyrene does not show any crystalline areas, and is essentially all an amorphous solid. Branched polyethylene shows approximately 60% crystallinity existing in a highly viscous fluid matrix. Linear polyethylene, as indicated, is even more crystalline and more nearly resembles a solid. Its density of 0.95, in comparison with 0.92 for branched polyethylene, is further indication of the packed nature of the product. Even though our charts indicate no polymeric branching in polystyrene and linear polyethylene, there may be a few occasional branches, but these are not significant insofar as the fundamental properties of the product are concerned.

In the last column on Figure 2, we have attempted to show the way these materials change their state upon heating. Polystyrene has a long, gradual softening range, while the polyethylenes melt more abruptly; the branched material melting at some 40° F. lower temperature than the linear polyethylene. These changes on heating affect many things, particularly the fabrication characteristics.

Polymerization Conditions

Typical polymerization conditions for these materials are shown in Table 1. For polystyrene, moderately high temperatures, low pressure, and no catalyst is a common polymerization procedure. In branched polyethylene, higher temperatures, extremely high pressures, and peroxide-type catalysts are often used. With linear polyethylene, the reaction takes place under low pressure and relatively low temperature, and with the use of an extremely active organo-metallic catalyst. The manufacture, handling, and use of this catalyst presents many difficulties.

There is no problem of removing catalyst from the polymerization of polystyrene. In branched polyethylene production, the catalyst is so completely used up that it presents no serious removal problem. In the production of linear polyethylene, however, the highly reactive catalyst may, under certain circumstances, leave a residue which presents certain problems. Obviously, the catalyst residue is not as reactive as the original catalyst.

but can be corrosive and must not be overlooked. One solution to the problem is to remove the residue from the plastic. Since complete removal may be extremely difficult, it is often necessary to render the remaining catalyst residue harmless by proper stabilization. The use of material containing excessive quantities of unstabilized catalyst residue can cause corrosion of the fabrication equipment, particularly the steel of injection molds.

Stabilization Methods

The problem of stabilization of plastic materials involves consideration not only of catalyst residue, but also the effect of oxygen and light. As such, heat stabilizers are necessary in some plastic materials. However, in the case of the three materials under discussion, the effect of heat is largely that of accelerating oxidative degradation. As shown in Table 2, special formulations may be used to extend the light-stable life of polystyrene. In general-purpose polystyrene, however, stabilizers usually are not included.

Branched polyethylene requires antioxidants for protection against oxidative degradation and, for light resistance, use of carbon black, special formulations, or both. For linear polyethylene, however, in addition to the stabilization problem of oxygen and light, there may be the problem of stabilizing against mold corrosion resulting from catalyst residues which may remain in the plastic. This stabilization problem is not an easy one, and is unquestionably one of the reasons why the linear polyethylenes have not reached the market more rapidly and in larger quantity.

Flow Properties

These three plastic materials have significantly different rheological properties or flow characteristics during fabrication, as shown in Figure 3. One of the first and most important rheological properties of polyethylene is its melt index. This is the number of grams of material that flows through a small orifice under a given pressure and at a given temperature in a given time. Generally speaking, the lower the melt index number, the stiffer the material. Included in Figure 5 are two grades of branched polyethylene that cover the normal range of injection molded polyethylene materials. It should be noted that a general-purpose, relatively easy molding polystyrene appears to have a low melt index comparable to that of linear polyethylene. From that one point alone, it could be expected that both materials would be stiff and hard to fabricate.

Let us now consider the plastic flow characteristics of these materials as they traverse through the injection molding cylinder. An important property in this consideration is melt viscosity. In the second column of Figure 3 is shown a typical melt viscosity measurement taken at a temperature of 400° F. A wide variation in viscosity can be seen; polystyrene appears to be far stiffer than any of the polyethylenes, and stiff Grade 2 branched polyethylene is about equivalent to linear polyethylene of much lower melt index. This indicates that these latter products should be fabricated at widely differing temperatures.

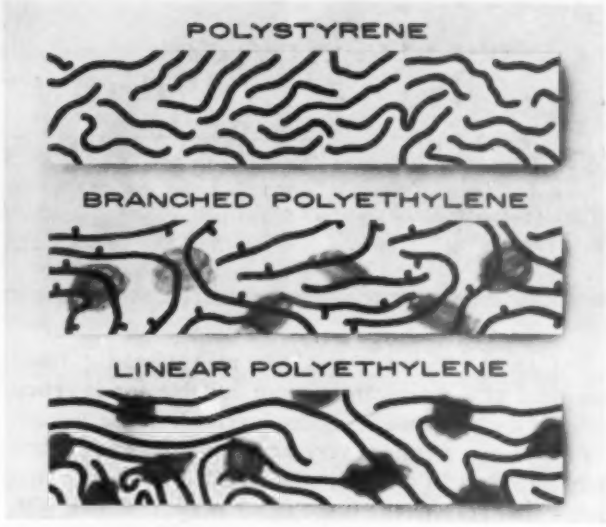

Fig. 1. Comparative molecular configurations of polystyrene, branched polyethylene, and linear polyethylene.

	MONOMER SIZE (MOL WT)	DEGREE OF POLYMERIZATION: AVE MONOMER UNITS	DEGREE OF POLYMERIZATION: AVE MOL WT	CRYSTALLINITY, PER CENT	DENSITY, GMS/ML	POLYMERIC BRANCHING	CHANGE OF STATE, °F
POLYSTYRENE	104	500	50,000	0	1.05	LOW	180 SOFTENING
BRANCHED POLYETHYLENE	28	710	20,000	60	0.92	HIGH	200 MELTING
LINEAR POLYETHYLENE	28	2100	60,000	75	0.95	LOW	240 MELTING

Fig. 2. Comparative fundamental properties of polystyrene, branched polyethylene, and linear polyethylene.

	MELT INDEX	MOLDING: MELT VISCOSITY (POISES) AT 400°F	MOLDING: MELT VISCOSITY AT MOLDING TEMP	MOLDING: MELT VISCOSITY AT MOLDING TEMP & PRESS., η_r	COOLING: RATE OF CRYSTALLIZATION	COOLING: SHRINKAGE	COOLING: DIMENSIONAL CONTROL
POLYSTYRENE	0.4	85,000	24,000 / 450°F	1,500 / 450°F	NONE	SMALL	SIMPLE
BRANCHED POLYETHYLENE	2.0	18,000	9,500 / 450°F	5,300 / 450°F	FAST	LARGE	COMPLEX
	200	2,800	5,000 / 350°F	1,700 / 350°F	FAST	LARGE	COMPLEX
LINEAR POLYETHYLENE	0.6	18,000	5,000 / 500°F	1,700 / 500°F	FASTER	VERY LARGE	MORE COMPLEX

Fig. 3. Comparative plastic flow properties of polystyrene, branched polyethylene, and linear polyethylene.

Table 1. Comparative Polymerization Conditions for Polystyrene, Branched Polyethylene, and Linear Polyethylene

	Typical Polymerization			
	Temp., ° F.	Pressure, psi.	Catalyst	Catalyst Removal
Polystyrene	300	0-50	None	None
Branched Polyethylene	500	20,000	Peroxide	Used up
Linear Polyethylene	200	50	Organo-metallic	Extraction difficult

The third column shows the melt viscosity when measured at a temperature more suitable for injection molding the particular product involved. These viscosities are measured under very low pressure and at essentially zero shear. From this consideration alone, it would appear that polystyrene is the much stiffer material, with free-flowing branched polyethylene and linear polyethylene being about equivalent in stiffness. Injection machines, however, do not operate at low pressure and zero shear. Our studies indicate that the average shearing stress on a plastic in an injection molding cylinder during operation at normal pressure is about 700,000 dynes per square centimeter.

	DEGREE OF STIFFNESS	YIELD STRENGTH	HEAT RESISTANCE (DEPENDS ON STRESS)	LOW TEMPERATURE TOUGHNESS	CHEMICAL RESISTANCE	COST PER PART
POLYSTYRENE	VERY HIGH	HIGH	MODERATE	POOR	FAIR	LOW
BRANCHED POLYETHYLENE	LOW	LOW	MODERATE	GOOD	GOOD	LOW
LINEAR POLYETHYLENE	HIGH	MODERATE	HIGH	VERY GOOD	VERY GOOD	MODERATE

Fig. 4. Comparative properties of moldings made from polystyrene, branched polyethylene, and linear polyethylene.

In the fourth column of Figure 3 are shown the effects of this pressure on the flow characteristics or viscosity of the material while at the recommended molding temperature and pressure. It will be noticed that these materials react far differently to this pressure or shearing stress. Polystyrene, for example, is much more sensitive to the effect of this shear stress; its melt viscosity having dropped from 24,000 to 1,500 under the increased pressure. Linear polyethylene shows flow characteristics about equivalent to those of the polystyrene, but has changed far less under the effect of the pressure. The change in flow of branched polyethylene falls between that of polystyrene and linear polyethylene.

The melt viscosity of Grade 2 material does not decrease as much as does that of linear polyethylene and, in particular, that of polystyrene. This effect is shown graphically in the curve of the fifth column. These curves indicate fluidity versus time during the cooling part of the cycle. The curve for polystyrene is relatively steep at the top, whereas that for polyethylene is flatter and shows the somewhat lesser effect of temperature at the high temperature ranges.

Polystyrene tends to stiffen gradually as it cools, while the polyethylenes stay relatively fluid and then harden abruptly when a certain temperature is reached. This temperature is higher in the case of linear polyethylene than in the case of branched polyethylene. During this cooling in the mold, recrystallization takes place in both branched and linear polyethylenes. The extent of crystallization is greater in the case of the linear polyethylene, and the rate of crystallization also is somewhat faster. This crystalline characteristic of these materials has an additional effect on molding problems in that the greater the extent of crystallization, the larger the shrinkage as the molding cools and crystallizes.

Accordingly, dimensional control on branched polyethylene and, particularly, on linear polyethylene is more complex than with polystyrene. With linear polyethylene, which is more crystalline than branched polymer, the rate of crystallization is faster and the crystallization begins at higher temperatures. Thus, the shrinkage is very large since it is due to both increased crystallization and thermal contraction over a wider temperature range. For this reason, the problems of dimensional control on linear polyethylene may be far

(Continued on page 108)

Table 2. Comparative Stabilization of Polystyrene, Branched Polyethylene, and Linear Polyethylene

	Catalyst Residue	Oxygen	Light
Polystyrene	None	None	Special formulations
Branched Polyethylene	None	Required	Carbon black and/or special formulations
Linear Polyethylene	Required	Required	Carbon black and/or special formulations

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Heat Distortion Temperature Measurements for Evaluation of Thermoplastics

The effects on test results of variables in the test method, specimen conditioning procedure, and material composition

The "softening temperature" of organic thermoplastic materials is recognized as an index of their physical characteristics. Few commercial plastics possess sharply defined softening temperatures; rather, they exhibit a gradual transition range of softening with temperature increase. To overcome the inconvenience of dealing with a ranged index, numerous arbitrary methods of test have been devised (1, 2)*. One widely accepted method (namely, ASTM Method D648) defines the heat distortion temperature as the temperature at which a bar of the thermoplastic attains a predetermined center deflection when subjected to a constant stress while being heated gradually.

In the following discussion, reference to the heat distortion temperature (H.D.T.) will be limited to the specific conditions designated by the ASTM method, whereas the term "flexural deformation temperature" (F.D.T.) will be used for broader interpretations of heating rates and stressing conditions.

The possible sensitivity and reproducibility of a heat distortion temperature measurement on thermoplastics has been demonstrated through thousands of tests made in our laboratories during the past few years. The importance of variables in the method of test, in the conditioning of the test specimen, and the effect of the composition of the material is the subject matter of this paper. The correlation of "softening temperature" data with flexural and tensile strength measurements at elevated temperature, as well as with simulated service temperature tests will be shown.

* Numbers in parentheses refer to bibliography at end of article.

Apparatus

The apparatus described has been evolved over a period of 15 years. It complies with the requirements of the ASTM method. The usefulness of this equipment has been expanded by incorporating features to make it more versatile. There are provisions for

(1) Testing various sizes and shapes of specimens.
(2) Testing over a wide range of applied stress.
(3) Using either air or liquid heating media.
(4) Using different heating rates.
(5) Obtaining creep data at elevated temperatures.

The equipment consists of the test unit, the temperature controller, and a liquid reservoir.

Test Unit

Figure 1 is a front view of the test unit showing the two testing heads in the raised position. The top plate of this unit supports the two test heads, the heating elements, and a stirrer motor. It is suspended by a thermal insulation rim on the inside tank which, in turn, is suspended by glass wool from the outside tank. The control switches and an auxiliary clock are mounted on the face of the outside tank. Connections are made at the back of the unit for introducing the heat transfer liquid and maintaining its level throughout the test by gravity drainage to the liquid reservoir.

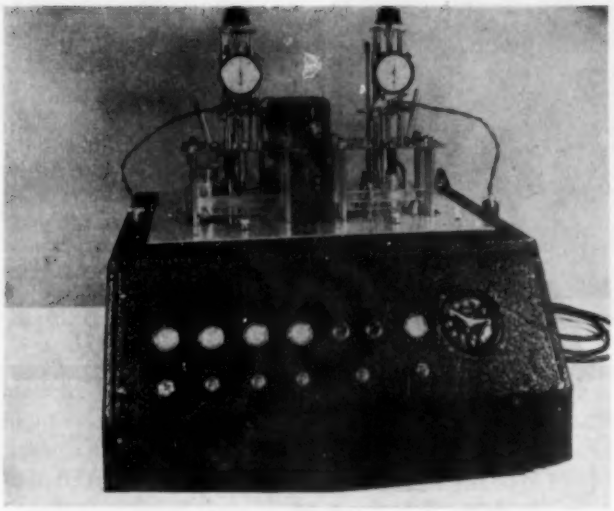

Fig. 1. Heat distortion temperature test apparatus.

Front and side views of a testing head are shown in Figure 2. The reference plane of this unit is a ⅛-inch thick stainless steel plate from which are suspended eight Invar rods. The four outside rods serve as guides and supports which permit the unit to slide in and out of the tank. It is held out of the tank by friction clips when changing specimens. The remaining four rods support the Invar test frame.

Mounted on the bed plate of the frame are two wedge-shaped Invar supports, rounded to ⅛-inch radius, upon which the specimen is placed for testing. The bed of the frame is drilled to accommodate specimen spans of two, three, and four inches. An Invar plunger, fitted with a wedge-shaped tip rounded to ⅛-inch radius and guided by a long bushing, is located midway between the supports. A circuit platform with a lip is fastened to the top of the plunger above the reference plate. The platform is of a convenient size to carry fixed weights which are brought to correct value by the addition of steel shot in an ointment can.

Two Invar guide posts support the dial micrometer and its adjustment screw. The tension spring is removed from the micrometer to avoid changes in tare weight of the platform when the positioning screw is adjusted to accommodate any specimen thickness. Deflection of the test specimen is read directly from the micrometer. Holders are provided in the top plate for positioning thermometers to nearly touch the specimen at its center. Small metal tanks for enclosing the test specimen and the steel test frame up to the reference plate are provided for conducting tests in air as the heating medium.

Temperature Controller

The temperature of the liquid in the test unit tank is controlled by a cam reset Brown recorder-controller with appropriate cams, the temperature can be increased from 0.1-5.0° C. per minute or held constant within ± 1.0° C. The test specimen temperature is read from a calibrated thermometer inserted in the well in the test head.

Liquid Reservoir

An insulated tank located directly under the test unit is used to receive overflow as the liquid heat transfer medium expands with temperature increase, and to provide a source of cold liquid for cooling the contents of the test unit tank. Cold water is circulated in a large coil of copper tubing inside the tank. The liquid is transferred to the test unit tank by a small pump.

Obviously, the choice of the heating medium is dictated by the nature of the materials being tested and the maximum test temperature requirement. Socony-Vacuum Oil Co.'s DTE Light Oil may be used up to 150° C. for most plastics.

Experimental Details

Instrumental

Simple beam formulas are used to calculate the loads required to produce selected outer fiber stresses, and we have prepared nomographs to facilitate these calculations. All data are recorded on cards, and immersion medium temperature and center deflection data are plotted subsequently on coordinates printed on the re-

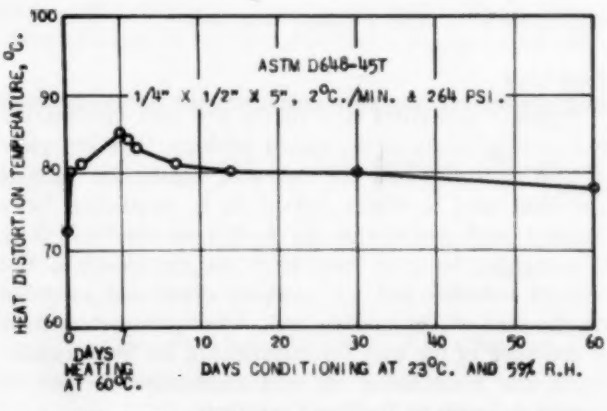

Fig. 3. Effect of conditioning time on heat distortion temperature of molded Plexiglas I-A.

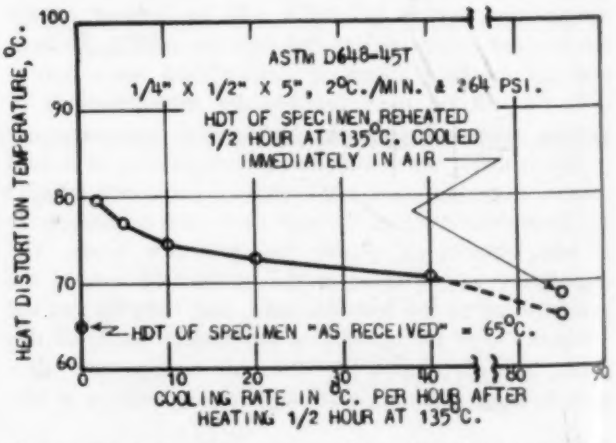

Fig. 4. Effect of cooling rate on heat distortion temperature of Plexiglas I-A after molding.

verse side of these cards as an aid to checking the test results and interpolating for exact end-points.

Attention must be given to many instrumentation details if close duplication of test results is required. Among these details are calibration of thermometers, elimination of friction in the loading plunger, elimination of errors in dial gage indication, and maintenance of heating rate. With proper attention to details, we have shown that test results on duplicate specimens can be reproduced to within 2° C.

Specimen Preparation

Unwarped specimens of rectangular cross-section and flat surfaces are required to obtain accurate test results. Crooked or poorly surfaced specimens yield excessive deflection readings because of buckling or indentation.

Specimens must be brought to a standard moisture content before reproducibility of H.D.T. test results can be obtained. The magnitude of moisture-conditioning effects for Plexiglas 1-A, a moderately moisture-sensitive material, is shown in Figure 3. It appears that two weeks conditioning in standard laboratory atmosphere (23° C. and 50% RH) are required to approximately equilibrate a ¼-inch thick specimen for this test.

Non-uniform internal stress distribution in the specimen can significantly effect the measured H.D.T. (3, 4). The magnitude of such effects is illustrated on Figure 4 in terms of the effect of rates of cooling of the test specimen from a temperature above the H.D.T. As shown in Figure 5, the effect of heating rate on the measured H.D.T., although important, is much less significant than moisture and internal strain conditioning when a liquid heat-transfer medium is used.

Significance of Test Results

The heat distortion temperature test yields data on flexural deflection at constant stress with changing temperature. Since plastic materials decrease in modulus and increase in rate of creep as their temperature is increased, the two factors contributing to deflection are additive. Figure 6 shows that the contribution of creep

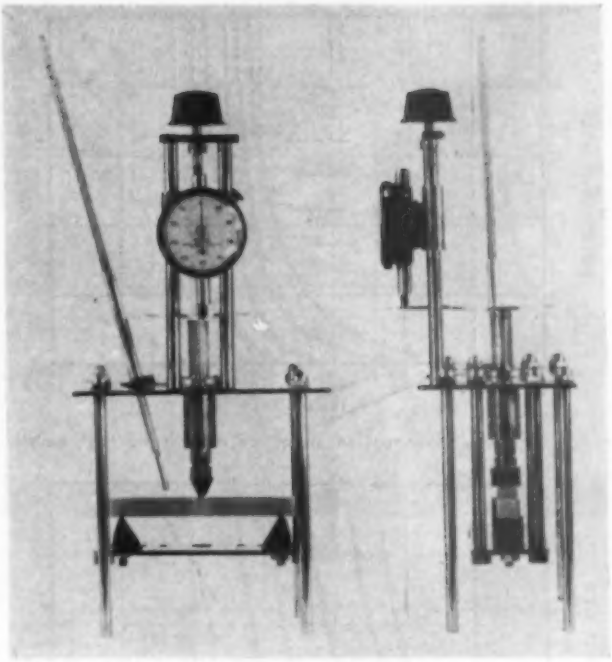

Fig. 2. Heat distortion temperature test heads.

increases significantly at temperatures above the H.D.T. end-point. Obviously, the creep contribution will be increased with increase in outer fiber stress. This effect on several thermoplastics is illustrated in Figures 7-9 (4, 5).

The limiting effect of chemical cross-linking of thermoplastics on their creep characteristics at low stress values is illustrated progressively in Figures 10-12. Thus, flexural deformation temperature tests made over a wide range of stresses provide a good method of detecting and comparing degrees of cross-linking (6, 7).

Flexural deformation temperature test results on thermoplastics show minimum temperature sensitivity at low stress and high deflection values. The usefulness of such values in predicting elevated temperature strength characteristics of materials is illustrated in Figure 13. The interference of chemical cross-linking

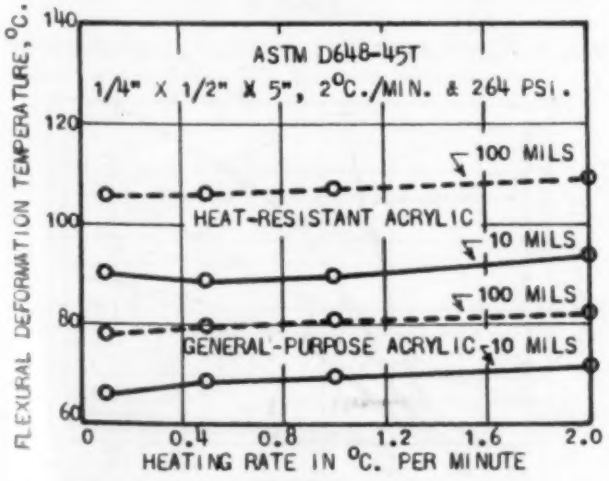

Fig. 5. Effect of heating rate on flexural deformation temperatures for two types of cast acrylics.

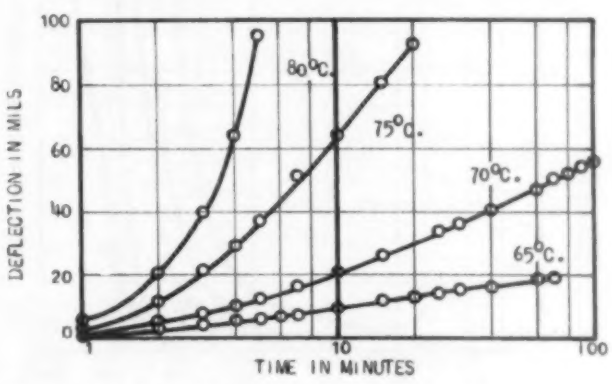

Fig. 6. Structural deformation with time of Plexiglas 1-A at constant temperature.

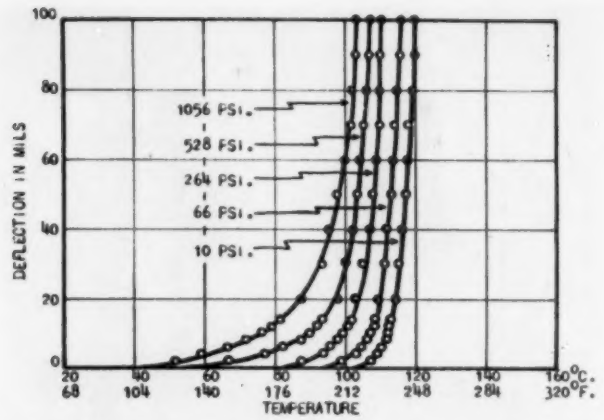

Fig. 7. Flexural deformation point of a heat-resistant acrylic.

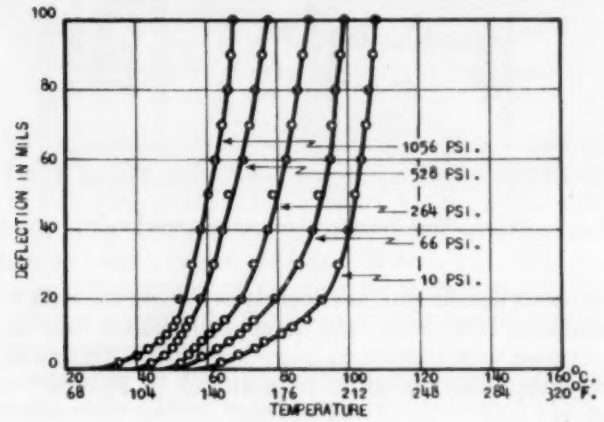

Fig. 8. Flexural deformation temperature of a cellulose acetate.

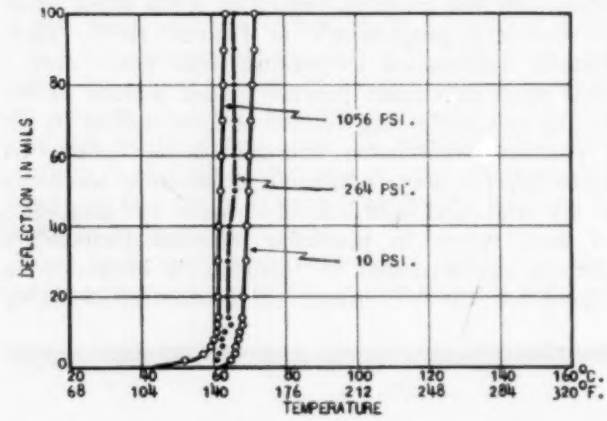

Fig. 9. Flexural deformation point of a vinyl chlorideacetate.

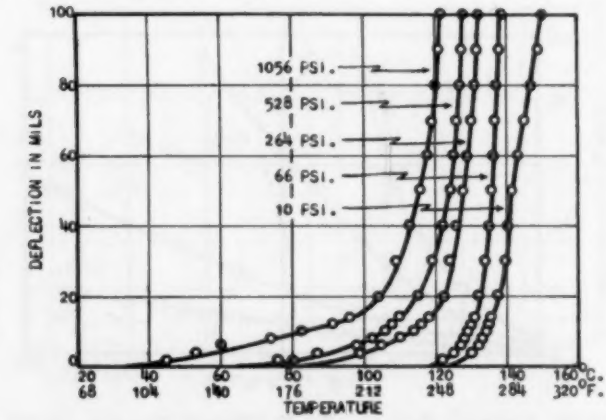

Fig. 10. Flexural deformation temperature of a modified acrylic.

with this method of prediction is illustrated by Figures 14 and 15.

Internal stress created by shaping operations frequently affect the dimensional stability of plastic parts. The nature of such instability is illustrated in Figure 16 for eight-inch diameter, one-inch deep, hot-drawn spherical sections. This section was chosen for test because it approximates many aircraft enclosures in contour and draw. The specimens were heated successively for 24-hour periods at 10° C. (18° F.) intervals starting at 50° C. (122° F.). At the end of each period, the sections were cooled to room temperature and measured for decrease in depth of draw.

The dimensional stability of the materials used to form these sections can be reasonably predicted by projecting the higher stress portion of the F.D.T. deflection curve to the zero stress level, as shown in Figure 17. Such an extrapolation combines a measure of the level of "softening temperature" of the material with a measure of the change of apparent softening temperature with moderately high values of stress.

Summary

An apparatus is described which complies with the requirements of the ASTM D648-45T Tentative Method of Test for "Heat Distortion Temperature of Plastics" and, in addition, possesses certain refinements in design

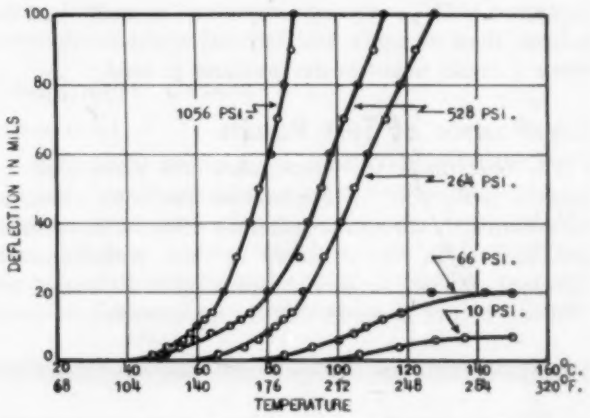

Fig. 11. Flexural deformation temperature of a cast polyester.

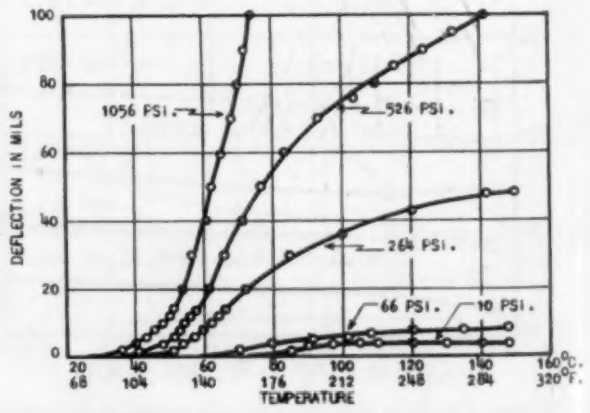

Fig. 12. Flexural deformation temperature of a cast allyl.

and adaptability. The importance of instrumental factors and test specimen conditioning is briefly discussed.

The effects of outer fiber stress on flexural deformation temperature are shown for heat resistant acrylic, cellulose acetate, vinyl chloride-acetate, modified acrylic, polyester, and allyl resins. The correlation of flexural deformation temperature to elevated temperature flexural and tensile strength values is shown for a heat-resistant acrylic, a modified acrylic, and a polyester. The use of flexural deformation temperature vs. stress data for predicting elevated temperature dimensional stability of formed parts is shown for heat resistant acrylic, modified acrylic, and polyester resins.

Acknowledgment

We should like to take this opportunity of expressing our indebtedness to L. T. Dunbar of our Physics Laboratory Instrument Shop for suggesting and incorporating many detailed features in the construction of our heat distortion temperature test apparatus.

Bibliography

(1) ASTM D648-45T "Tentative Method of Test for Heat Distortion of Plastics."

(2) "Heat Distortion Temperature," Federal Specification L-P-4068, Method 2011.1 (September 27, 1951).

(3) J. A. Melchore and H. F. Mark, "Effect of Strains on Heat Distortion," **Modern Plastics**, 31, 3, 141 (Nov. 1953).

(4) K. J. Cleeveman, H. J. Karam, and J. L. Williams, "Heat Distortion of Polystyrene," ASTM Bulletin, 180, 37 (Feb. 1952).

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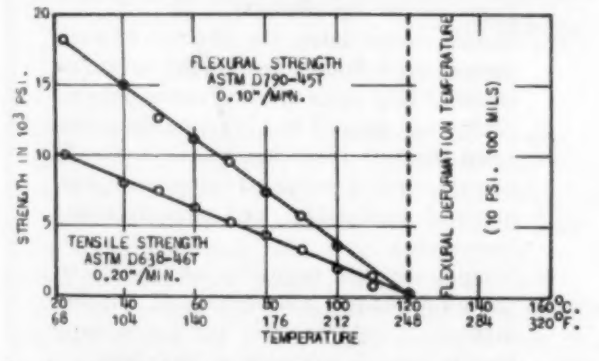

Fig. 13. Correlation between strength properties and flexural deformation temperature of a heat-resistant acrylic.

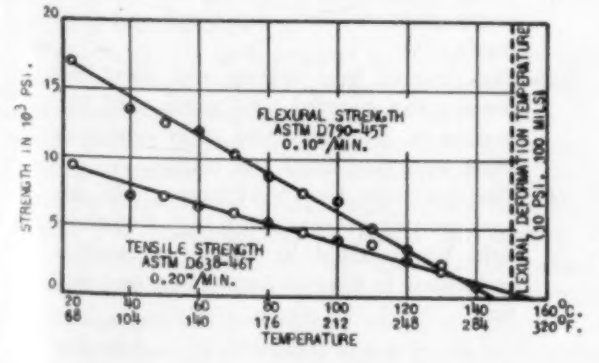

Fig. 14. Correlation between strength properties and flexural deformation temperature of a modified acrylic.

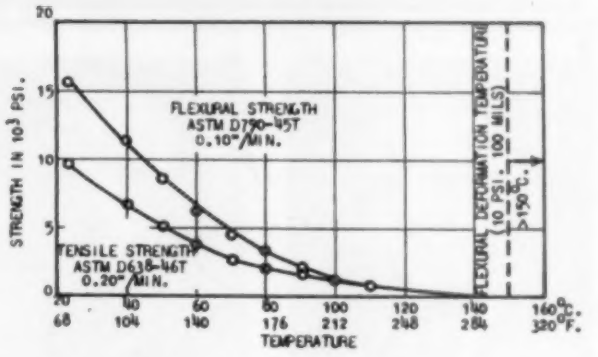

Fig. 15. Correlation between strength properties and flexural deformation temperature of a polyester.

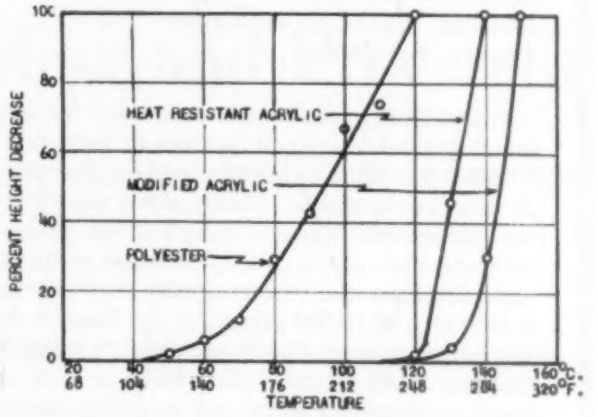

Fig. 16. Thermal relaxations of plastic domes after 24-hours cumulative heating at various temperatures.

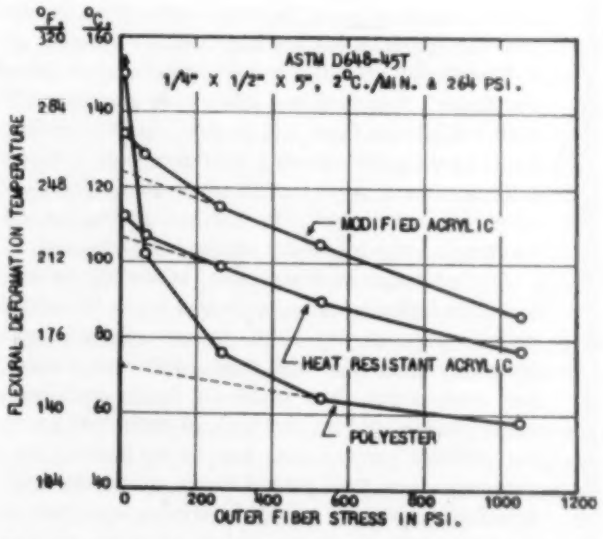

Fig. 17. Effect of stress on plastic flexural deformation temperatures of acrylic and polyester.

Guest Editorial

Fabian Bachrach

Progressive Improvements in Vinylfoam

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A low-density cushioning material with the well-established inherent good qualities of vinyl resin, Vinylfoam is made by our patented gas absorption process. Introduced to industry about three years ago, the material is one of today's fastest growing products. Four of the 25 U. S. licensees operating under the Elastomer patents already are producing a daily total of 10,000 pounds of vinylfoam in the form of sheet stock. Others are engaged in manufacturing molded items, either alone or with integral slush-molded skins and mounting inserts, such as used for automotive instrument panels, arm-rests, and padded sun visors. The ease of heat sealing Vinylfoam to flexible films and fabrics makes it a "natural" for upholstered furniture, handbags, belts, and other women's accessories. It has been chosen after extensive tests for seat padding in new and reconditioned New York City subway cars. Deep embossing by electronic means, either alone or on or between other films, makes possible hitherto unknown decorative effects.

Vinylfoam currently is being produced in densities from 3.5 pounds per cubic foot and upwards; with resiliencies from soft to firm; dead or springy feels; varying load-bearing characteristics; uniform cell structure; low temperature flexibility; and numerous other desirable physical properties, depending on the ingenuity of the vinyl chemist.

The potential of Vinylfoam, according to conservative industry opinion, should reach 50-million pounds per year by 1960. It not only competes favorably price-wise with foam rubber on a pound per comparison, but since all foam cushioning materials are sold on the basis of their load-carrying abilities, overall cost has to be figured on a volume rather than pound basis. Since the compression resistance or load-carrying qualities of Vinylfoam are merely the result of formulation variations and know-how, and not wholly interdependent with density as in the case of foam rubber, this will reflect appreciably and favorably on the unit-volume price of Vinylfoam.

Other advantages of Vinylfoam as compared with latex foams are:

(a) Low capital investment with consequent low amortization cost for a given plant capacity (about 30% of a comparable foam rubber installation).

(b) Unlike rubber latex, the absence of ever-present price fluctuations of the basic raw material (the price of vinyl resins only recently was reduced by 17%, and the downward trend of plasticizer prices is a well-known result of increased competition, raw material availability, and manufacturing know-how).

(c) Scrap losses are negligible and, since no chemical changes take place, all uncured material is fully reusable and cured scrap may be used in calendering operations.

(d) The foaming process may be continuous or interrupted at will, without necessitating costly plant shutdown and cleaning procedures.

(e) The ease of heat sealing and deep embossing the material, and subsequent formation of laminates and other combinations with vinyl films and textiles.

(f) The discovery that Vinylfoam could advantageously be cured in a high-frequency field has resulted in further substantial reductions in over-all production cost and time.

—THE END

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Compounding and Processing Styrene Copolymer Resins

Details on the properties of the resins, and their compounding and processing for the manufacture of tough, rigid plastic parts.

Dynamic and constantly expanding, the plastics industry has been relentless in its pursuit of truly high-impact thermoplastic resins. Through such resins, the industry can continue to enlarge its utility and, thus, make more significant and vital contributions to its growth and that of the people whom it serves.

Without exception, our experience has been that the first test applied to a molded or extruded part is a destructive test. These tests are made because the molder is seeking an answer to one question: Will the resin give a part rugged enough to withstand abuse in fabrication, shipment, and use?

This desire for high-impact materials is not new. Several years ago, special vulcanized resin-rubber blends were developed. Tested in many spectacular ways, the blends proved successful in compression and transfer molding. However, one serious objection was raised; the injection molders needed high impact in thermoplastic, not thermosetting, materials. An analysis of their needs indicated that they wanted a high-impact thermoplastic resin with a minimum impact strength of five foot-pounds per inch of notch.

The recent entry of several resins in the high-impact field indicates that many materials suppliers also thought this need was real. Among those who have done extensive research and development on this project is Goodyear, which started its search for a high-impact thermoplastic resin some six years ago. The solution to high impact was not easy, and in the intervening years many resins were made and evaluated in the laboratory. Those resins which showed promise were then evaluated in selected plant trials. As deficiencies and weaknesses were noted, the resins were returned to the laboratory for further work. The development process was long and often discouraging but, because the need was genuine, a good high-impact resin of the styrene copolymer type finally was introduced under the trade-name of Plio-Tuf.

These resins are not the end but only the beginning, for industry is research-minded and further development of high-impact resins must and will occur. Since the plastics industry cannot wait for the future, but must act now, it is necessary to consider the high-impact resins presently available.

The high-impact resins can be used by plastics engineers in almost every known and existing method of fabrication. The various resins can be injection, transfer, or compression molded; they can be milled, Banburied, calendered, or extruded; and they can be machined or post-formed. These resins can be used to

bridge the existing gap between soft, flexible materials and hard, brittle polystyrene.

To obtain a high-impact thermoplastic resin without any sacrifice of other physical properties would be ideal. Unfortunately, such a perfect resin is not now available; some concessions in other properties must be accepted if high impact is desired. Considering the so-called negative factors first, the high-impacts, when compared with polystyrene, usually are (1) slightly lower in hardness; (2) opaque and less glossy; (3) lower in ultimate tensile and higher in elongation; and (4) lower in stiffness. In reality, many of these "negative" factors may be positive, since they afford greater latitude and opportunity to the designer and engineer in achieving new objectives.

The positive factors of high-impact resins offer much to the plastics industry. Naturally, the outstanding property is the high impact value inherent in the resins. In addition, the impact strength can be varied, with attendant variations in other properties, by compounding with other materials. Thus, in addition to impact, these resins offer a heat distortion equivalent to polystyrenes; more flexibility than polystyrene, affording more latitude in design and applications; and a better brittle point than polystyrenes, thus giving a greater latitude in temperatures at which the resins can be used. It is this combination of properties, and not high impact alone, which makes the high-impact resins attractive.

To deal in generalities is not enough, for the engineer must work with facts. He must determine some of the data for himself, but he also is entitled to know the properties of the resin offered for his consideration. Accordingly, this discussion on Plio-Tuf will be presented in three major phases; (1) properties of the resin; (2) compounding; and (3) processing, including mixing, extrusion, and molding.

Properties of Plio-Tuf

There are two basic Plio-Tuf resins, G85C and G75C, each designed for specific needs. Plio-Tuf G85C is a hard, brittle resin with a high tensile strength and a high heat distortion point. It is designed primarily as a modifying resin for use in blends with other resins and with elastomers. Plio-Tuf G75C is a high-impact resin with a high heat distortion point, and is designed for use alone, although it can be blended with other resins and elastomers. Its inherent high impact and easy fabrication, however, make it desirable as an injection molding or extrusion resin.

Some of the physical properties of the resins, both alone and in blends with each other, are shown in Table 1 and Figure 1.

These data show a family of blends ranging from low to exceptionally high impact strength, with attendant variations in hardness, stiffness, and tensile strength. These variations permit the selection of an appropriate resin ratio for use in specific applications.

Table 1. Properties of Blends of Plio-Tufs G75C and G85C.

Composition, parts:					
Plio-Tuf G75C	100	75	50	25	0
Plio-Tuf G85C	0	25	50	75	100
Properties:					
Tensile strength, psi	3,000	4,000	5,000	6,000	6,200
Elongation, %	20-30	5-20	5-10	0-5	0-5
Hardness, Shore D	72	75	80	85	85
Izod impact, ft.-lbs./inch of notch	9.0	5.7	2.0	0.5	0.3
Olsen stiffness at 77° F. (20° deflection of 1 x 4 x 0.075-in. span), lbs. to bend	0.44	0.68	0.72	0.78	0.87

Behavior Upon Aging

One of the more important aspects of a resin is the way it ages. Therefore, a typical Plio-Tuf resin was subjected to various aging conditions, as shown in Tables 2, 3, 4, and 5.

The data after oven aging (Table 2) show that tensile strength and stiffness are unchanged; elongation is decreased and hardness increased slightly; and the notched Izod after eight weeks exposure at 158° F. was 80% of the original value. After an exposure of 30 days in a Weatherometer (Table 3), slight increases were observed in tensile strength, hardness, and stiffness, and the resin retained 80% of its original impact strength value. After 30 days exposure in a Fadeometer (Table 4), unchanged tensiles were accompanied by slight increases in hardness and stiffness, and the notched Izod of 3.1 foot-pounds/inch of notch was 64% of the original value. The data after 20 months of normal laboratory aging (Table 5) show slight increases in tensile strength and stiffness, a moderate decrease in elongation, no change in hardness, and an Izod impact that is 87% of the original value.

This aging data show that Plio-Tuf is more sensitive to light than to heat, and indicates that interior applications are preferable to exterior uses.

Chemical Resistance

The chemical resistance of resins is important, and Table 6 shows the effects of some common chemicals on Plio-Tuf G75C. The resin shows excellent resistance to alcohols, alkalies, acids (other than strong oxidizing

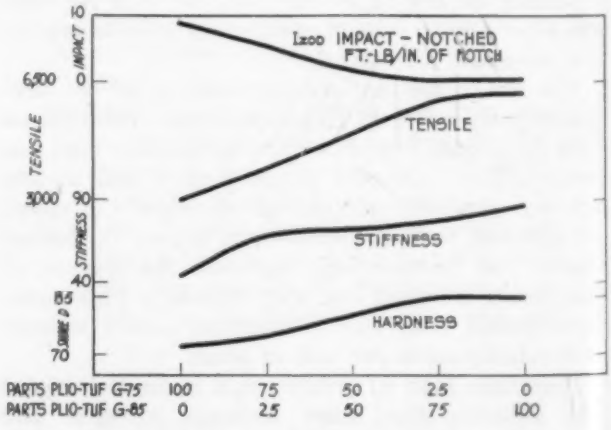

Fig. 1 Properties of Blends of Plio-Tuf G75C and G85C.

Table 2. Plio-Tuf Properties after Geer Oven Aging.

	Original	Weeks in 158° F. Oven 2	4	6	8
Tensile strength, psi	2,525	2,660	2,510	2,590	2,515
Elongation, %	45	38	25	31	31
Hardness, Shore D	78	79	80	80	81
Izod impact at 77° F., ft.-lbs./inch of notch	5.2	5.3	4.8	3.6	4.2
Olsen stiffness at 77° F. (20° deflection of ½ x 4 x 0.125-inch span), lbs. to bend	1.46	1.44	1.40	1.48	1.40

Table 3. Plio-Tuf Properties after Weatherometer Aging.

	Original	Days in Weatherometer 6	12	18	24	30
Tensile strength, psi	2,525	2,600	2,685	2,650	2,650	2,695
Elongation, %	45	5	13	10	5	6
Hardness, Shore D	78	79	79	80	82	81
Izod impact at 77° F., ft.-lbs./inch of notch	5.2	4.8	4.6	4.5	4.5	4.0
Olsen stiffness at 77° F. (20° deflection of ½ x 4 x 0.125-inch span), lbs. to bend	1.46	1.50	1.48	1.46	1.56	1.50

Table 4. Plio-Tuf Properties after Fadeometer Aging.

	Original	Days in Fadeometer 6	12	18	24	30
Tensile strength, psi	2,525	2,575	2,500	2,605	2,580	2,585
Elongation, %	45	3	3	4	3	3
Hardness, Shore D	78	80	81	81	81	82
Izod impact, ft.-lbs./inch notch	5.2	3.9	2.8	3.3	3.5	3.1
Olsen stiffness at 77° F. (20° deflection of ½ x 4 x 0.125-inch span), lbs. to bend	1.46	1.38	1.46	1.50	1.48	1.60

Table 5. Plio-Tuf Properties after Normal Laboratory Aging.

	Original	Months in Laboratory 4	8	12	16	20
Tensile strength, psi	2,525	2,625	2,595	2,630	2,800	2,835
Elongation, %	45	28	38	35	40	10
Hardness, Shore D	78	78	79	78	76	77
Izod impact, ft.-lbs./inch notch	5.2	3.0	3.5	4.9	4.9	4.5
Olsen stiffness at 77° F. (20° deflection of ½ x 4 x 0.125-inch span), lbs. to bend	1.46	1.38	1.44	1.48	1.50	1.56

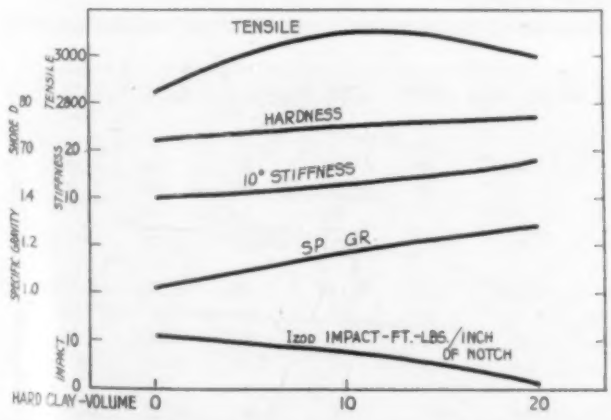

Fig. 2. Effects of pigment loadings on properties of Plio-Tuf G75C.

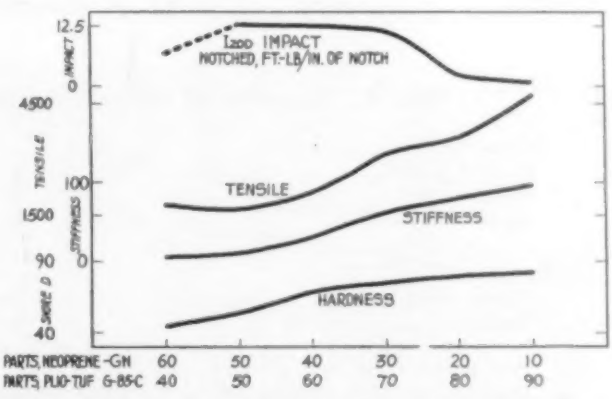

Fig. 3. Properties of unvulcanized blends of Plio-Tuf G85C and Neoprene GN.

Table 6. Chemical Resistance of Plio-Tuf G75C.

	% Swelling after Immersion for	
	24 Hours at 77° F.	7 Days at 77° F.
Acetic acid, 50%	0.28	1.84
Hydrochloric acid, 50%	0.55	0.26
Nitric acid, 50%	0.53 discolored	0.52 discolored
Phosphoric acid, 50%	0	0
Sulfuric acid, 50%	0.88 discolored	0.28 discolored
Sodium hydroxide, 50%	0	0.49
Ammonium hydroxide, 25%	0.72	1.98
ASTM #1 oil	0	0
ASTM #3 oil	1.64	4.18
Ethylene glycol	0.83	—0.77
Ethyl alcohol	0	0.74
Petroleum grease	0.51	1.50
Hexane	63.2	89.8
Gasoline	90.3	121.1
Toluene, methyl-ethyl ketone, and acetone	Deteriorated	Deteriorated

acids such as sulfuric and nitric), and aliphatic and aromatic oils. It has less resistance to aliphatic and aromatic solvents and ketones.

The staining effects of some common household materials also were studied. Among those tested and showing no effect on the resins after 24 hours contact were laundry chemicals (bluing, Chlorox, "All" detergent, Ivory soap, and Rit dyes); beverages such as coffee, milk, and orange juice; condiments such as mustard, vinegar, and catsup; and foods such as butter, chocolate, jelly, mayonnaise, oleomargarine, and raw meat.

Compounding

Compounding is the technique by which selected plasticizers, pigments, elastomers, or other materials are incorporated into a resin for the purpose of developing its desirable properties even, if necessary, at the expense of others. There are several ways by which the Plio-Tuf resins can be compounded. In Figure 1 and Table 1 were shown the variations possible by blending hard, brittle Plio-Tuf G85C with tough Plio-Tuf G75C to secure intermediate blends having a considerable range in tensile strength, hardness, stiffness, and impact strength.

The resin also may be compounded by using loadings of inexpensive pigments. These pigments increase properties such as hardness, stiffness, and tensile strength, but usually reduce the impact strength of the resin. Consequently, loadings should be limited to not more than 10 volumes of pigments per 100 parts of resin. The data shown in Table 7 and Figure 2 are for clay-loaded stocks, and are typical of results obtained with clay and other pigments.

Table 7. Effects of Pigment Loadings on Plio-Tuf G75C.

Clay volumes	0	10	20
Specific gravity	1.02	1.17	1.29
Tensile strength, psi.	2,850	3,100	2,980
Elongation, %	60	35	10
Hardness, Shore D	72	75	77
Izod impact, ft.-lbs./inch			
of notch	11.0	7.8	1.2
of width	S16.3	16.3	3.0
Heat distortion at 66 psi. load, °F	200	203	201
Compressive strength, psi.	3,500	3,600	4,400
Olsen stiffness, lbs. to bend at			
10° deflection	10	13	18
20° deflection	18	24	33

Table 8. Properties of Unvulcanized Blends of Plio-Tuf G85C with Neoprene GN.

Composition:						
Plio-Tuf G85C	90	80	70	60	50	40
Neoprene GN	10	20	30	40	50	60
Calcium carbonate	0.1	0.2	0.3	0.4	0.5	0.6
	100.1	100.2	100.3	100.4	100.5	100.6
Properties:						
Tensile strength, psi	4,700	3,600	3,130	2,080	1,650	1,725
Elongation, %	5	10	65	45	118	120
Hardness, Shore D	83	80	75	69	54	44
Izod impact, ft-lbs./inch of notch	0.6	2.3	11.5	12.0	12.7	6.7*
Olsen stiffness (30° deflection of 1 x 4 x 0.075-inch span), lbs. to bend	0.96	0.80	0.62	0.30	0.10	0.04

* Sample too soft for adequate test.

A third way to compound the Plio-Tuf resins is to blend them with any neoprene or GR-S type rubber. These uncured blends give a family of stocks ranging from polystyrene-like properties at one extreme to polyethylene-like properties at the other. Stocks in all content ratios may be transfer or compression molded, but only the higher resin ratios can be injection molded.

For this type of compounding, the harder Plio-Tuf G85C is preferred. Typical properties of this resin in uncured blends with neoprene are shown in Table 8 and Figure 3.

Processing

The resins can be processed easily on existing rubber and plastics mills, and in internal mixers. In mill mixing, temperatures of 250-300° F. must be used.

The grinding of these mixes or of scrap mixtures does require some caution. Since the resins have very high impact strengths, it is possible to overload the grinder and cause it to stall or overheat. Good grinding practice dictates the moderate feeding of high-impact resins to the grinder.

Sheet Fabrication

Plio-Tuf G75C has been extruded in sections ranging from small pipe and refrigerator breaker strips to sheeting that is 48 inches wide and ⅛-inch in thickness. Sheeting also can be made from calendered stock which then may be press-polished and embossed. To secure sheeting from this latter method, it has been found that calender roll temperatures of 300° F., embossing temperatures above 325° F., and moderate pressures are satisfactory.

Physical property data on extruded Plio-Tuf sheet are given in Table 9.

Table 9. Properties of Extruded Plio-Tuf Sheet.

	Transverse	Longitudinal
Tensile strength, psi.	2,930	2,990
Elongation, %	30	25
Crescent Tear strength lbs./inch of width	725	685

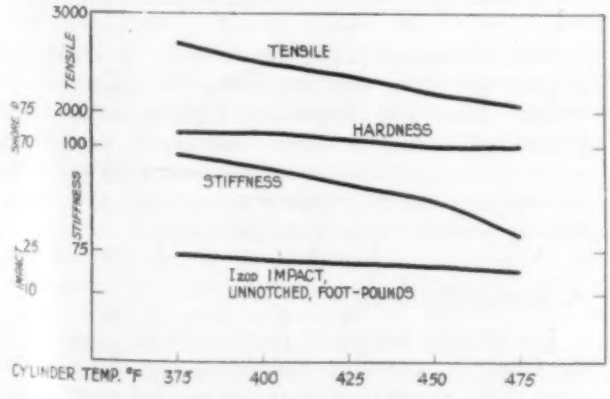

Fig. 4. Effects of cylinder temperature at constant injection pressure on properties of Plio-Tuf G75C.

The conditions used to extrude sheet 48 inches wide and 0.125-inch thick on a 3½-inch NRM extruder are shown in Table 10.

Studies show that the following five conditions are very effective in extruding satisfactory sheet:

(1) Heated air-circulating hoppers and cool feed sections aid in securing better resin feed and, thus, more freedom from surge.

(2) Since the full effect of pressure on the die is desired, a coarse screen pack should be used in conjunction with the breaker plate.

(3) Die-land length depends on the configuration of the extruded section. For pipe extrusion, the land should be at least four times the wall thickness. For sheeting, land length requirements increase with the sheet thickness and the sheeting die length. Good extrusions have been made where the sheeting die land length was at least 8-10 times the extruded sheet thickness.

(4) A temperature gradient across the sheeting die is very effective in controlling plastic flow within the die, and is essential in the production of full-width sheets. Such gradients are in the order of 380° F. at the die center, 420° F. at each end of the die, and intermediate temperatures between the die ends and center.

(5) Extruder screw type is a definite factor, especially when the production rate is important. The screw should have a compression ratio of 1.7:1 or higher for pellets, and 4:1 or higher for powders. Of the various types of screws tested, the full-torpedo type has given the least success, and the short torpedo and short-flighted torpedo types have been better. Maximum success has been obtained with full-flighted screws; one of the best had a compression ratio of 3:1, single flights up to the modified 4½-inch torpedo, and a length-to-diameter ratio of 20:1, exclusive of the feed opening.

Once a sheet has been made, either by press-polishing or extrusion, conventional preheating and post-forming equipment can be used to form deep draws having high impact strength and excellent definition.

Injection Molding

The high-impact resins have been injection molded on standard equipment, using molds gated and designed for polystyrene and butyrate. While both conventional and

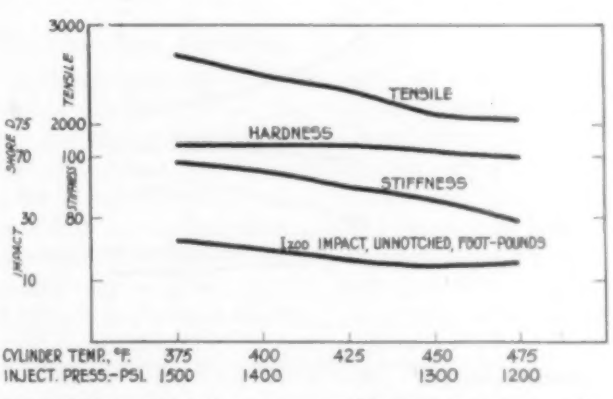

Fig. 5. Effects of injection pressure and temperature on properties of Plio-Tuf G75C.

Table 10. Extrusion Conditions for 48-Inch Wide, 0.125-inch Thick Sheet.

	Extruder Zones						
	No. 1	No. 2	No. 3	No. 4	No. 5	Throat	Gate
Barrel temperature, °F.	250	285	320	350	400	—	410
Die temperature, °F.	410	380	360	390	415	—	—
Die pressure, psi.	500	800	1,100	750	500	1,200	1,550

Temperatures of take-off rolls: Top & bottom rolls, 210° F.
Middle roll, 200° F.

pin-hole gating have been used, conventional gating is preferred.

In developing the Plio-Tuf resins, many studies were made on the influence of molding conditions. From these studies, it was concluded that the appearance of the finished piece is not the sole criterion for evaluating high-impact resins, since improper molding can destroy the inherent physical properties of the resins.

During development, it was found that strain-free Plio-Tuf pieces could be boiled without distorting. It also was determined that the ASTM heat distortion points were 195° F. at 66 psi. fiber stress and 175° F. at 264 psi. stress; in other words, the greater the stress, the lower the heat distortion point. Thus, if no visible stress is applied to a piece that deforms at a temperature lower than the claimed heat distortion point, the piece probably has internal strains that are residual from stresses induced during molding. This illustrates how improper molding can destroy the inherent heat distortion of the resin.

Figure 4 shows the effects of cylinder temperature variations on the properties of Plio-Tuf G75C molded at a constant injection pressure. It is evident that increasing the cylinder temperature causes a decrease in the resin's tensile strength, hardness, stiffness and impact strength.

In Figure 5 is shown the effects of higher pressures at reduced temperatures on a constant molding cycle for Plio-Tuf G75C. In this case, the product of pressure and temperature was held nearly constant. These data show tha high-impact resins molded at 1,500 psi. line pressure and 375° F. temperature are superior to those molded at lower pressures and higher temperatures. It is shown that tensile strength, hardness, stiffness, and impact strength decrease as the temperature is raised and the pressure is lowered.

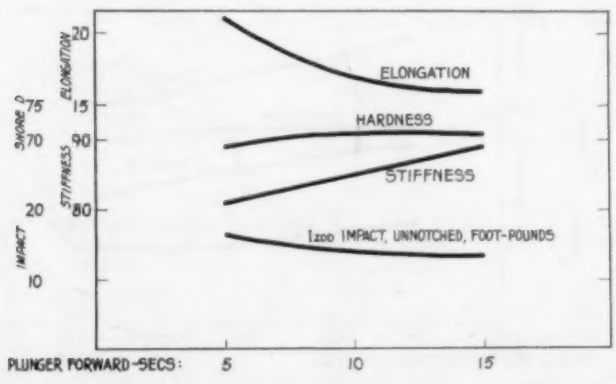

Fig. 6. Effects of injection plunger forward time on properties of Plio-Tuf G75C.

The effect of plunger time on the properties of Plio-Tuf G75C is shown in Figure 6. It appears that the length of time the plunger is forward helps to put strains into the piece. While the piece becomes harder and stiffer as plunger forward time increases, the unnotched impact strength drops off. Experience also has taught that reducing the plunger forward time can assist in mold release, probably because fewer strains are induced.

Mold temperature has a significant effect on piece properties, and warm molds should be used for high-impact resins. This heat helps to reduce strains, aid flow, and improves weld lines and gloss. If properly used, such temperatures can assist in mold release; holding the moving mold half to 10-30° F. lower than the temperature of the stationary mold half causes the piece to cling to the cooler half of the mold and to the knock-out pins, helping in mold release. The exact mold temperature to use must be correlated with cylinder temperature and cycle time.

Mold release agents can be used, but not until all molding conditions have been balanced. For this purpose, the metallic stearates, high-melting waxes, and other commercial release agents have been satisfactory.

Conclusions

The high impact strength and attendant properties of these styrene copolymer resins justify the serious consideration of the plastics industry. The high-impact resins can be processed and fabricated in existing and conventional equipment. To obtain the most value from the resins, they should be given adequate evaluation time.

The high-impact resins should not be confused with polystyrene which they are meant to supplement, not replace. They are opaque and high in impact, while polystyrene is high in clarity and low in impact. The properties of the high-impact resins are such as to offer the designer and the industry an opportunity to bridge existing gaps in the available materials.

Acknowledgments

The authors appreciate the invaluable assistance of the Goodyear chemical engineering and research divisions in the preparation of the resins, and thank Goodyear for permission to publish this paper. —The End

Reinforced Epoxy in Airline Tray Carriers

Construction details, production operations, and advantages of carriers made of glass-reinforced epoxy laminates with CCA cores.

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Domestic and overseas airlines are constantly striving to improve their service to the public so that a prospective traveler will call on them first when there is a choice of transportation. These efforts delve into many phases of carrier operation, among which one of the most rewarding is the maintenance of a high-quality catering service. Knowing that the passenger is likely to remember the quality of the meals served on board for a long time, the airlines go to great lengths to make the meals as wholesome and fresh-tasting as possible.

Several companies have even been casting about for better food tray carriers, because the metallic carriers generally used are assembled by spot-welding sheet aluminum sections together, and offer many crevices where food particles may hide. Despite frequent and repeated washings, the metallic carriers eventually absorb the smell of mixed foods.

To solve this problem, American Airlines first investigated the use of plastic tray carriers, and turned to reinforced polyester as an alternate material. Several trial batches of tray carriers were built and put into service. They held up quite well under the strain, except for one drawback. The detergents used to clean the trays after each trip would cause bits of the polyester resin to chip away from the glass fiber reinforcement, apparently due to failure of the bond between the two.

When we were approached with this problem, we suggested a different type of construction, as well as different materials. It was our belief that the spalling action of the detergent could be eliminated by using epoxy resins, and that a much stronger, yet lighter, assembly could be produced by using sandwich-type panels. Our confidence in the epoxies for this application has been justified by the more than 125 tray carriers we have built so far (see Figure 1). These carriers have already rendered more than a year of trouble-free service, and are still in use today.

Construction Methods

The most expensive part of tooling up to produce the plastic tray carriers was the building of a metal mold for the carrier shell. Since no draft tolerance is permitted, the mold had to be designed in such a way that it could be collapsed and withdrawn once the plastic shell had cured. This design took a lot of ingenuity by members of the tool and die department to work out a satisfactory solution. The final result is visible in Figure 2, which shows the mold being removed from a finished tray carrier shell.

In operation, the three-part mold, clamped and ready for use, is hoisted onto a special dolly which permits it to be rolled into the curing oven. As shown in Figure 3,

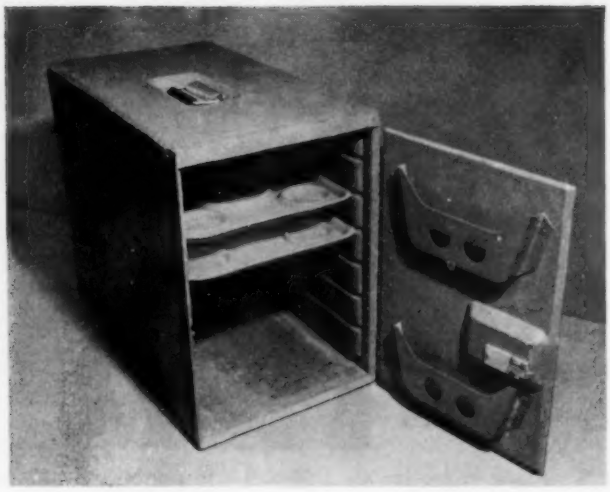

Fig. 1. Finished plastic food tray carrier holds 14 trays. Dry ice may be packed into holders mounted on door and back wall of carrier.

the dolly also incorporates a connection for a vacuum line to exhaust the air from the interior of the mold, and two radiant heating elements which help to maintain uniform temperatures throughout the part being cured.

Once the mold has been placed on the dolly and coated with parting agent, it is sprayed with an epoxy formulation containing Shell Chemical Co.'s Epon 828 resin, curing agent Z (about 20 parts per 100 of resin), a reactive diluent, and enough pigment to secure the standard gray color specified by American Airlines.

After the mold has been sprayed with the Epon resin-based formulation, glass cloth, glass mat and cellular cellulose acetate (CCA) are applied to varying thicknesses, as listed in Table 1. Because of space limitations, the back of the tray carrier was made considerably thinner than the other panels.

The sides, tops, and bottoms of the carriers are built in this manner. Two-ounce glass mat is placed over the mold which has already received a coat of Epon formulation. Inasmuch as the formulation also acts as an adhesive, no other means of holding the cloth in place is needed. This mat layer is given a spray-coating of the epoxy resin formulation (see Figure 4).

Next, especially prepared sections of CCA are tied on with cotton thread. These sections are prepared from standard ½ by 8-inch or ¾ by 6-inch cellular cellulose acetate "lumber" which is suitably cemented, planed, and routed to achieve the desired panel dimensions. Additional formulation is sprayed on, followed by another layer of glass mat. To prevent warpage or residual stresses in the tray carrier after curing, the bottom and top layers of glass mat are "balanced;" i.e., they both face either toward or away from the CCA core.

Cast phenolic inserts and 181 type glass cloth are used to reinforce the corners of the tray carrier. Figure 5 is a cross-sectional drawing of one of the carrier sides, showing the details of construction.

Fig. 3. Steel mold for carrier is hoisted onto dolly. Dolly top has two vacuum lines and two radiant heating elements at its center.

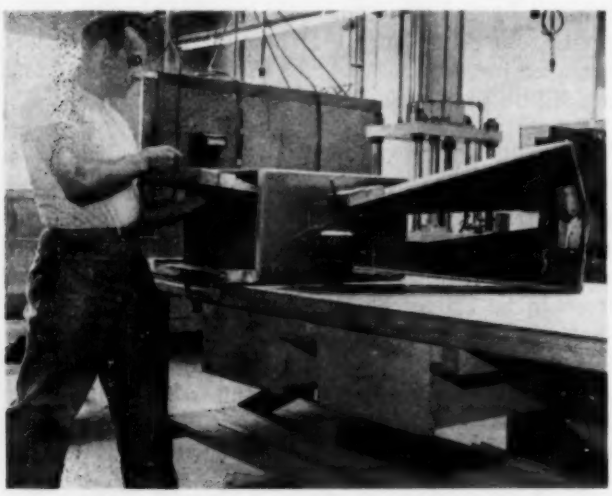

Fig. 2. Mold being collapsed for withdrawal from molded tray carrier shell.

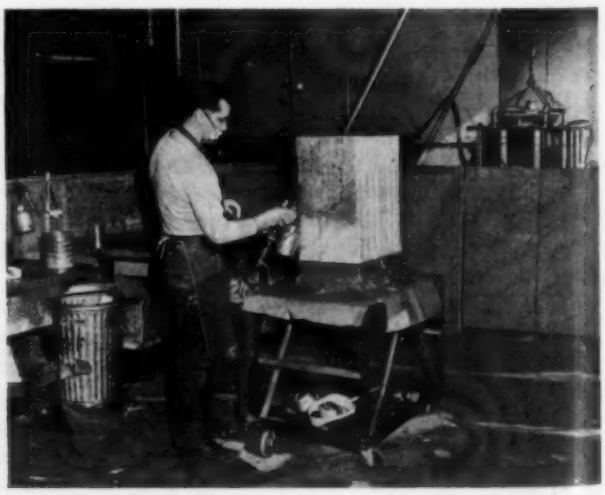

Fig. 4. Resin formulation being sprayed on first layer of glass mat applied to mold.

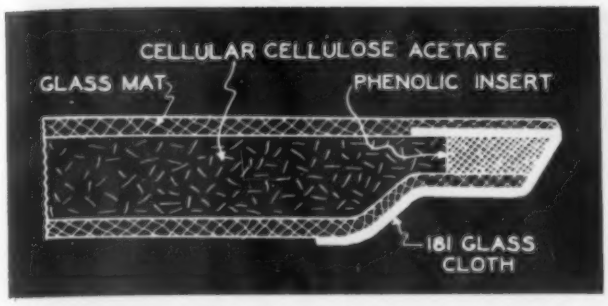

Fig. 5. Cross-sectional drawing showing how front edges of carrier are reinforced to protect against accidental damage.

When the lay-up is completed and the final cost of epoxy formulation has been sprayed on, a polyvinyl alcohol plastic bag, tailored for a snug fit, is pulled over the assembly. Wrinkles are worked out as well as possible, and any excess PVA is pulled to the "bottom" panel of the finished carrier. Rubber gaskets and a web strap are used to seal the PVA bag to the tray carrier being molded, so that no air can enter when a vacuum is applied to the inside of the mold.

The whole assembly is then wheeled into an oven at 220° F. (see Figure 5), and withdrawn after about 15 minutes. This short heating period reduces the viscosity of the resin so that entrapped air can be worked out, and also softens the PVA bag so that it can be pulled smooth and taut before the final bake. The assembly is returned to the oven where, with a 25-inch vacuum applied to the mold's interior, the cure is completed in 1½ hours.

After curing, the mold and carrier are hoisted off the dolly. While still suspended from the crane, the inside of the mold is sprayed with water to cool it, thus facilitating its removal. To get the mold ready for the next carrier, all vacuum holes are drilled out and fresh parting agent is applied to the surfaces.

Use of Epoxy Molds

Essentially the same procedure is followed in building the door, as well as the two ice trays which are mounted on the inside of the door. The one important difference is that the molds themselves are not made of metal, but utilize almost identically the same materials as the parts being formed. To prepare the mold, Epon 828 resin was mixed with curing agent Z and powdered aluminum in a ratio of 10:2:20, poured over a suitably-prepared wooden model, and allowed to cure at 175° F. for two hours.

Using the metal-filled epoxy resin for molds helped hold down the tooling-up costs involved in making the tray carriers. Whereas it took only eight hours to make the plastic molds, machining them out of solid metal could easily have taken five times as long, with a proportionate increase in cost. Also, metal molds are much heavier, and more difficult to modify in case of machining error or design change.

The epoxy molds have stood up very well in use, and have imparted the finest details to the parts being cured. For example, the arrows in Figure 7 point to two hair-

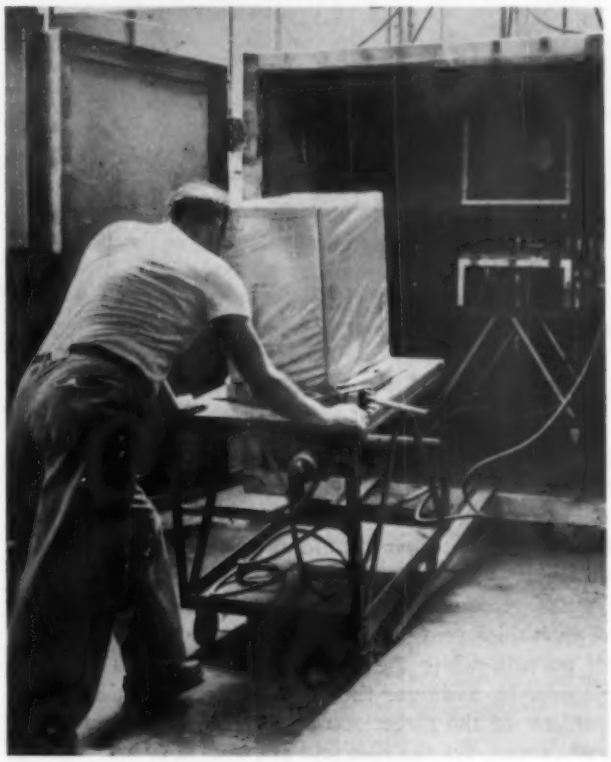

Fig. 6. Door and body of carrier are wheeled into curing oven. Body has been covered with PVA curing bag.

lines engraved in the matched mold set. These lines are faithfully reproduced in the cured part and serve as

Table I. Construction Details for Plastic Tray Carriers

Member	Sides	Top	Bottom	Back	Door
Inner layer	Glass mat	Glass mat	Glass mat	181 glass cloth	181 glass cloth
Thickness, mils	50	50	50	12	24
Core material	CCA*	CCA*	CCA*	Glass mat	CCA*
Thickness, in.	0.750	1	0.375	0.030	0.375
Outer layer	Glass mat	Glass mat	Glass mat	181 glass cloth	181 glass cloth
Thickness, mils	50	50	50	12	24
Total thickness**, in.	0.850	1.100	0.475	0.054	0.423

* Cellular cellulose acetate.
** Thickness after curing and includes the several coats of Epon resin formulation which have been sprayed on during the lay-up.

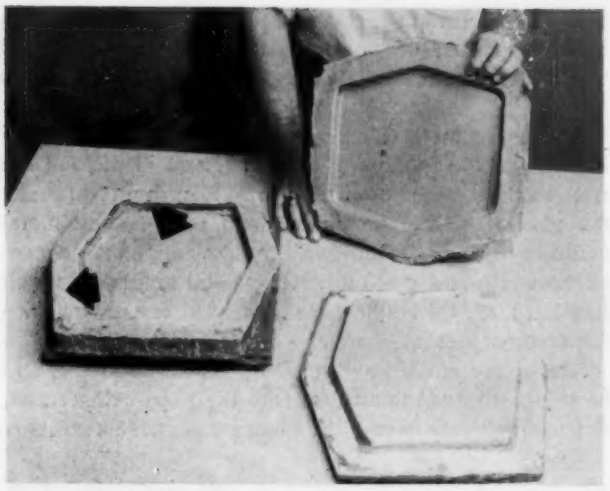

Fig. 7. Matched epoxy mold set used to make molded part (upper right) from which two ice holders are cut. Trim lines (arrows) on female mold half are faithfully reproduced on molded part.

Fig. 8. Metal dies are bolted to lay-up of carrier door to form permanent identification lettering. Square insert on door forms a depression where door handle and catch may be fastened.

guides when trimming the dry-ice trays, which are molded two at a time.

Part of the specification called for the familiar "AA" of American Airlines to be embossed in the door. The letters are impressed into the wet lay-up on top of the PVA bag by means of metal dies (see Figure 8), and are permanently formed during the cure.

Advantages of Epoxy Carriers

Although the primary reason for developing plastic tray carriers was to achieve better sanitation, these nonmetallic units offer several other important advantages. For one thing, and this may be hard to believe, they are not as heavy as their aluminum counterparts. The plastic carrier using the sandwich construction weighs 15.4 pounds. A comparable carrier made wholly of standard ⅛-inch thick reinforced polyester laminate weighs about 20 pounds, while the aluminum unit weighs some 17 pounds. In addition, the sandwich construction is the sturdiest of the three. A man can stand on top of the tray carrier, yet the unit will not buckle or warp out of shape, and the door can be opened or closed without any difficulty.

Another advantage offered by the plastic carrier is that it is easily repaired. Tough as it is, the carrier may fall or be pushed into a protruding bolt or the like with sufficient force to damage a panel. In that case, the hole need only be filled with freshly-catalyzed Epon formulation, covered with a strip of glass cloth, and cured. The resulting patch is easily sanded down and blended in with the surrounding area.

If similar damage were incurred by an aluminum tray carrier, it would have to be patched, thus offering still more food-retaining crevices. If a completely new panel should be required, it is doubtful whether repair would be practical inasmuch as the labor involved in undoing the spot welds and rewelding the replacement panel might easily cost as much as a complete new carrier.

Our experience with the epoxy resins used to build the tray carriers indicates that they have a tremendous potential. Not only did they make possible a stronger and more detergent-proof laminate, but they also helped minimize our tool costs. Profiting from our experience with this application, we have since expanded the use of the epoxies into other tooling applications where these resins have stood up equally well.

As an example, an epoxy forming die used on a 90-ton press formed more than 2,500 pieces of 0.020-inch thick stainless steel before showing any signs of wear. Even then, it was a simple matter to repair the die and put it back on the press for another run in less than a day. We think this is an enviable record for a plastic.

—THE END

Heat Distortion Temperature Measurements for Evaluation of Thermoplastics

(*Continued from page 93*)

(5) J. P. Tordella, A. C. Weber, and E. B. Cooper, "Measurement of the Effect of Temperature on Some Physical Properties of Plastics." "Symposium on Plastics Testing—Present and Future," STP No. 132, American Society for Testing Materials, Philadelphia, Pa. (1952).

(6) T. E. Bockstahler, G. E. Forsyth, J. J. Gouza, F. R. Shirek, and E. M. Beavers, "Thermal Properties of Polyester Resins —Influence of Cross-Linking," **Ind. Eng. Chem.**, 46, 1639 (Aug. 1954).

(7) L. S. Moody and K. B. Goldblum, "A New Interpretation of Heat Distortion Data of Plastics," ASTM Bulletin, 150, 55 (Jan. 1948).

(8) J. A. Sauer, F. A. Schwertz, and D. L. Worf, "Relative Temperature Stability of Stressed Plastics," **Modern Plastics**, 22, 7, 153 (March 1945).

(9) E. DiLiberti, S. A. Eller, and D. H. Kallas, "An Improved Method for Determining Heat Distortion Temperature," **Plastics**, 2, 2, 117 (Feb. 1945).

(10) G. Lubin, "Measuring Heat Distortion of Plastics," **Modern Plastics**, 23, 163 (March 1946).

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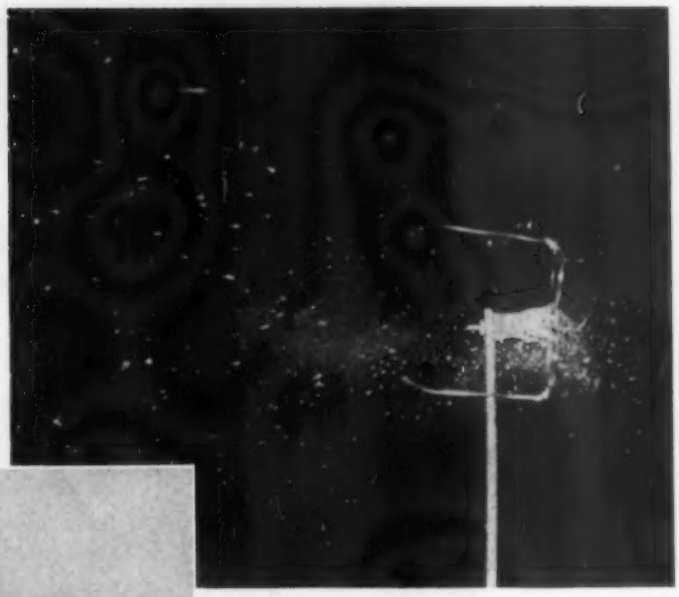
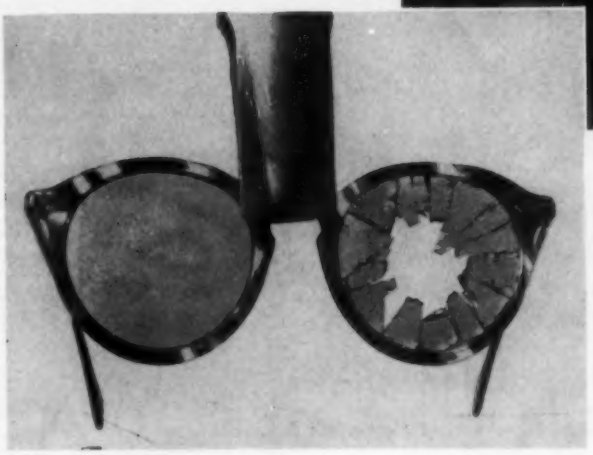


Split-second photo of spectacle in shotgun test shows glass lens (bottom) shattering and spraying glass, while allyl plastic lens (upper) is unharmed.



Spectacle after shotgun tests shows glass lens (right) shattered, while Armorlite plastic lens (left) is undamaged.

Shotgun Tests Prove Safety of Allyl Spectacle Lenses

Dramatic shotgun tests have demonstrated the superior eye safety obtained with spectacles containing allyl plastic lenses instead of conventional glass lenses. At the San Gabriel Valley Gun Club, 16-gauge shotgun rounds were fired at pairs of spectacles in which the left lens was of conventional glass, and the right lens was of Armorlite plastic, a product of the Armorlite Lens Co., Inc., Pasadena, Calif.

All lenses were of identical power, thickness, and size, and the shotgun was locked in a vise and sandbagged so that a consistent shot pattern could be obtained. Rounds were fired at five-yard intervals from 35-50 yards. In each case, the glass lens shattered and was blown out of the spectacles. At shot distances of 35 to 40 yards, the Armorlite lens cracked, but did not shatter, and stayed in the spectacles. At 45 and 50 yards, the Armorlite lens resisted the shot impact and remained in perfect condition. As shown in the accompanying photographs, cameras were used to record the test results.

The Armorlite lenses are made of thermosetting allyl plastic produced from CR 39, allyl diglycol carbonate. The lenses are cast in polarized condition and aged to power. They can be produced in standard form (without power), or can be made to meet prescription requirements. Available in a choice of color tints as well as colorless, the lenses are said to have uniform density and to be clearer than the finest glass lens.

In addition to impact resistance superior to case-hardened safety glass of equal thickness, the allyl lenses are claimed to be inert to chemical action; heat resistant; have one-half the weight of class, therefore more comfortable to the wearer; have 10 times the welding spatter resistant of glass; have 40 times the scratch resistance of methacrylate; and to be 4½ times more fog resistant than glass. —THE END

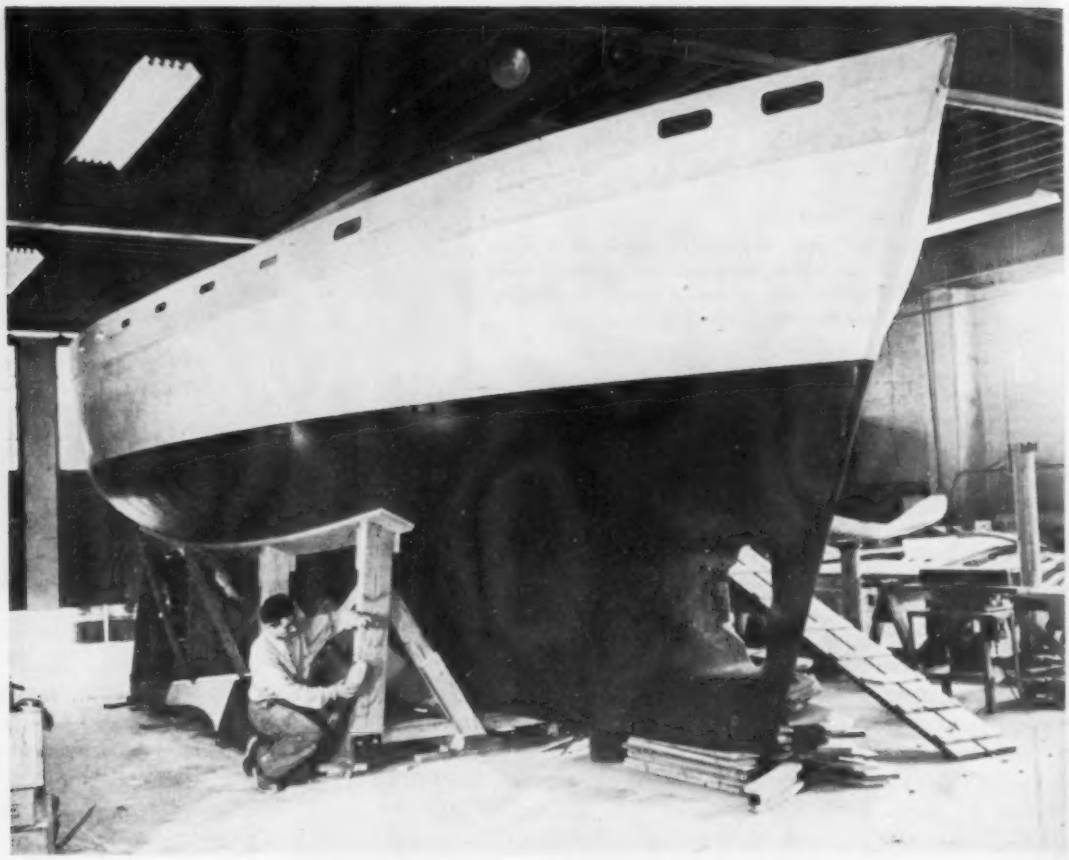


Fig. 1. Finished reinforced plastic hull for Arpege, ready for shipment.

Reinforced Plastic Hull on 42-Foot Sailboat

The Arpege, a 42-foot, 16-ton auxiliary ketch built for a two-year scientific expedition to the South Pacific next summer, has a Fiberglas-reinforced plastic hull (see Figure 1) constructed by a revolutionary new method. This new method eliminates the need for a permanent mold and expensive tooling, and makes practical the custom building of boats 20 feet or more in length for roughly the same cost as comparable wooden hulls.

Built under the supervision of Jean Filloux, French explorer, and Georges Hoffman, a marine architect, the Arpege was constructed and outfitted at the plant of Luria-Cournand, Inc., Havre de Grace, Md., who with 26 other companies and organizations sponsored the boat in the interests of increased technological and scientific knowledge.

The new method of making the hull makes use of the "composite hull" construction concept; a thin inner shell of mahogany veneer shaped over conventional boat forms and covered with Fiberglas cloth and polyester resin. The forms are removed when the plastic sets, and the shell becomes an integral part of the hull. The reinforced plastic is impervious to marine borers, relatively unaffected by the elements, and stays trim, leakproof, and rot-free with minimum maintenance. Since the hull is made in a one-piece, seamless unit, it never needs caulking, requires a minimum of metal fastenings, and is readily repaired.

The first stages of construction of the Arpege followed usual boat-building practice. The hull was built keel up. When its forms were set in place (see Figure 2), light battens of poplar, willow, or other "junk" lumber were nailed to them to create the contours of the hull. Sheets of vinyl film were stretched over the battens and stapled in place to prevent the veneer laminate from adhering to the battens and forms.

The first layer of veneer was stapled in strips ⅛-inch thick and four inches wide (see Figure 3). These strips were fastened diagonally to the battens with Monel staples. Woven Fiberglas cloth in 11-ounce construction, made by Hess & Goldsmith Co. from yarns produced by Owens-Corning Fiberglas Corp., was saturated with

Borden Co.'s Cascophen resorcinol resin glue and sandwiched between the first and second layers of veneer to provide necessary stiffness before the third and fourth veneer layers were added. All four layers of veneer were bonded together with the Cascophen glue and stapled.

According to Filloux, the last two veneer layers were added for extra strength to withstand the extreme conditions the Arpege may encounter in its cruise. He estimates that two plies of veneer would be adequate for most pleasure and commercial boats.

A specially-compounded mixture of American Cyanamid Co.'s Laminac polyester resins was brushed on the outer surface of the veneer. The glass cloth, 44 inches wide and rolled up on paper tubes, was laid on the hull (see Figure 4) and covered with Laminac resin. A cloth lap-over of about six inches was provided to insure over-all strength, and all joints were butted and staggered in successive laminate layers. In this heavy hull, as many as 19 layers of fabric were used in a continuous operation, and a total of 30 layers were applied in building the keel sections.

When the last layers hardened (see Figure 5), the

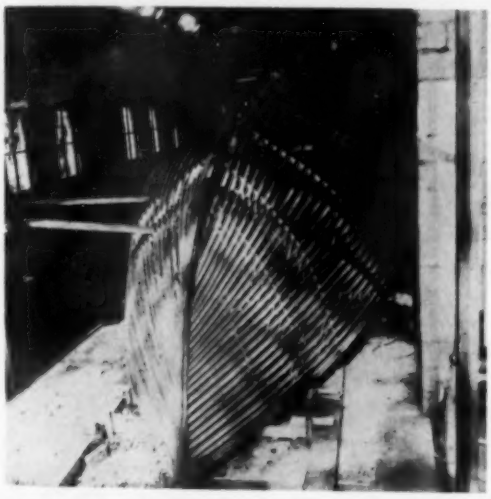


Fig. 2. Frame of form for reinforced plastic boat hull.

Fig. 3. First layer of mahogany veneer is stapled to hull battens and forms over vinyl sheeting used to insure release of finished hull.

Fig. 4. Applying Fiberglas cloth to form outer layers of hull.

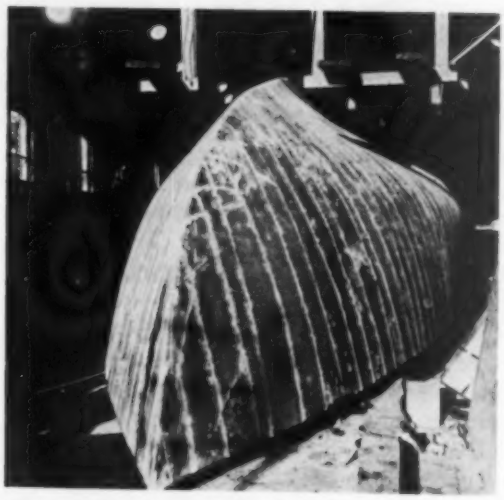


Fig. 5. Hardened reinforced hull form ready for final coats of pigmented resin.

Fig. 6. Empty shell of formed hull has mahogany interior and laminated plastic exterior finished in pigmented resin.

When the last layers hardened (see Figure 5), the hull was sanded and given several final coats of pigmented resin; dark green for the bottom, and white for the topsides. The completed hull was turned over with slings, and the forms, battens, and vinyl films removed from the inside (see Figure 6). The ballast of reinforced concrete was poured into the deep well. The bulkheads, made by Luria-Cournand from paper honeycomb impregnated with phenolic resin and reinforced with Fiberglas and polyester, were secured in place with Monel fastenings and sealed with Hesgon woven glass tapes and epoxy resin.

The cabin floor, sides, top, and deck, all of wood, were fastened with Monel screws and bolts, and covered with Fiberglas cloth and resin. The masts were stepped in the reinforced concrete ballast which also served as a base for mounting the engine, generator, and other equipment.

After fitting out in New York and a series of shakedown cruises, the Arpege will be sailed by Filloux and a two-man crew to the South Pacific where they will collect data on the relationship of winds and swells in an attempt to improve weather forecasting.

—THE END

Plain Talk on Polyethylene

(Continued from page 88)

more involved than with branched polyethylene.

As with polystyrene, we have learned of the molding of branched polyethylene from photographic studies in an injection mold having a glass window. This film technique of studying flow of plastic materials into a window mold has taught us a great deal about the rheology of polystyrene and branched polyethylene. We believe that similar studies on linear polyethylene will provide equally important information. This same rheology related to injection molding has considerable bearing on the extrusion characteristics of these materials. In addition, the subject of orientation during or subsequent to the extrusion can have considerable effect on physical properties of the product produced. This orientation effect is more pronounced with linear polyethylene.

Properties of Moldings

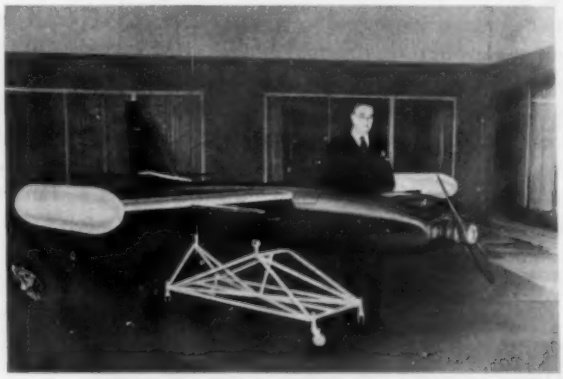
These three basic materials not only show differences in fundamental properties, methods of manufacture, and rheology, but also show considerable differences in the properties of the moldings (see Figure 4). One of the outstanding properties of linear polyethylene is its stiffness. It has a higher yield strength than branched polyethylene, but not as high as polystyrene. It shows improved heat resistance over both branched polyethylene and polystyrene. It has excellent low temperature toughness. Its chemical resistance is improved over that of branched polyethylene, and is significantly better than that of polystyrene. Inexpensive moldings from linear polyethylene should be possible from the standpoints of the base material cost and the low fabrication cost.

Conclusions

In comparison with polystyrene and branched polyethylene, we conclude that linear polyethylene is significantly different; is difficult to produce, but progress has been rapid; and presents added stabilization problems. Linear polyethylene poses fabrication problems, but its fabrication technology is expanding rapidly and is assisted by experience with branched polyethylene and polystyrene.

We believe that linear polyethylene creates new markets and strengthens some older markets. As such, linear and branched polyethylenes are predicted to be the first billion-pound per year plastic material.

—THE END



Radioplane's RP-77 pilotless, radio-controlled, plastic target drone.

Aircraft Drone Uses Glass-Polyester Plastic Construction

A radio-controlled plastic target drone airplane has been developed by Radioplane, subsidiary of Northrop Aircraft, Inc., Van Nuys, Calif. Named the RP-77, the drone is capable of speeds from 350-400 miles per hour in flights ranging from sea level to very high altitudes, and is designed for use principally as a target for gunnery, rocketry, and missile training.

The drone is constructed by a method perfected by Radioplane in building the Air Force's XQ-10, the first plastic pilotless aircraft. In constructing the drone, glass fiber cloth is applied in layers which are bonded and reinforced by polyester resins. The plastic possesses a high impact resistance, an important factor since the drones are recovered by parachute and reused. Unless destroyed by gunfire, the drones usually can be repaired easily in the field.

According to the company, the RP-77 has been designed on proved drone principles, using equipment selected and developed during the firm's long history of drone development. Radioplane presently manufactures the OQ-19, the standard operational drone in the military services, and has delivered more than 40,000 pilotless aircraft to the Armed Forces.

—THE END

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GLASS FABRICS

News of the Societies

SPE Elects 1956 National Officers at Annual Conference

The election of new national officers and another record registration (well in excess of 2,000) were the highlights of the 12th annual National Technical Conference of the Society of Plastics Engineers, Inc., held at the Hotel Statler, Cleveland, O., on January 18-20.

The new officers, elected by the Society's national directors, are as follows: president, Jerome L. Formo, Minneapolis-Honeywell Regulator Co.; vice president, Jules W. Lindau, III, Southern Plastics, Inc.; secretary, P. W. Simmons, Dow Chemical Co.; and treasurer, Wayne I. Pribble, Pribble Plastics Products, Inc.

The three-day conference saw the presentation of over 60 technical papers at the morning and afternoon concurrent sessions. Attendance at each individual session averaged 500, with several in excess of 1,000. Other highlights included the annual banquet on January 19, at which the guest speaker was Dr. Tennyson Guyer, Cooper Tire & Rubber Co.; the annual business luncheon on January 18; the past presidents' luncheon; and a full program of activities for the ladies.

Retiring president Frank W. Rinehart, National Bureau of Standards, was presented with a gavel in token of the Society's appreciation of his efforts during the past year. The presentation was made following the banquet, at which time the new national officers were introduced. Incoming president Jerome Formo, in a brief talk, outlined growth plans and called for the cooperation of all members to assure future success for the organization.

The Society now has 4,766 members, according to the latest official count. Charters were presented to three new Sections; Osaka (Japan); Kentuckiana, which includes the area around Louisville and Evansville; and Pioneer Valley. The latter is a name change from that originally submitted, Worcester-Leominster.

New Officers at New York

The New York Section, SPE, celebrated another year of expansion at the annual Christmas party on December 21 at the Gotham Hotel in New York City. The gala affair included a cocktail hour, dinner, and an elaborate entertainment program, all of which were enjoyed by a record attendance of 175 members and guests. A scroll was presented to Peter Henry Merz, Samuel B. Eppy & Co., the 500th member to become affiliated with the New York Section.

Palmer Humphrey, R. C. Molding, Inc. and outgoing president of the Section, presided over a brief business session following dinner, introducing the new Section officers and directors for the coming year, as follows: president, Guy Martinelli, Sylvan Plastics, Inc.; vice president Irvin I. Rubin, Robinson Plastics Co.; secretary-treasurer, George Leaf, Leaf Plastics, Inc.; and local directors (for three-year terms), George Baron, Ideal Plastics Corp.; George Lubin, Bassons Industries, Inc.; and Howard S. Dudley, American Cyanamid Co.

Mr. Humphrey thanked the outgoing officers, directors, and committee chairmen for their work during the past year. Appreciation was also expressed for Mr. Humphrey's work, and he was presented with a gift as a token of the Section's high regard for his services.

A number of table favors were distributed, and the evening was concluded with a drawing for some thirty door prizes donated by member companies.

Plastics House Competition

Plastics suitable for housing are documented and indexed in a new architect's reference file compiled by the Society of the Plastics Industry, Inc., and available to entrants in the recently-announced SPI Plastics House Competition. About 75 companies are represented in this file that lists resources for technical and nontechnical literature, and includes magazine articles showing fabrication and installation of plastics for building.

The Competition is aimed at developing ideas for new uses of plastics which will provide increased livability, comfort, safety, and value in home construction. Applications entered in the contest should have plastics used in ways that emphasize their physical characteristics. A total of 12 prizes are being offered to architects, designers, draftsmen, and architectural students. Closing date for the contest is May 20, and entry forms can be obtained from J. T. Lendrum, University of Illinois, Urbana, Ill.

The Competition is open to all architects, draftsmen, or architectural students in the United States, Canada, and any other country. There are not restrictions as to the organizational affiliation of any entrant. Awards will be presented to the winners at the seventh National Plastics Exposition, to be held in New York, N. Y., on June 11-15, 1956.

Wire & Cable Meeting Abstracts

The Fourth Annual Wire and Cable Symposium was held at the Berkeley-Carteret Hotel, Asbury Park, N. J., December 6-8, with 703 representatives of 243 industrial firms in attendance, both record figures.

The event, sponsored by the Signal Corps Engineering Laboratories, tele-communications division, Fort Monmouth, N. J., had for its topic "Technical Progress in Communication Wires and Cables." Twenty-two technical papers were presented by experts from the Signal Corps and industry, the latter including representatives of English and Swiss firms.

H. L. Kits, Signal Corps Engineering Laboratories, was chairman of the event and head of the committee in charge of arrangements. H. F. X. Kingsley, SCEL, was co-chairman. Others on the committee were R. Blain, Signal Corps Plant Engineering Agency; E. J. Burrough, E. I. du Pont de Nemours & Co., Inc.; P. H. Grogan, General Cable Corp.; B. Jore, Anaconda Wire & Cable Co.; E. L. Love, Whitney Blake Co.; and C. T. Wyman, Bell Telephone Laboratories.

Brig. Gen. Earl F. Cook, Commanding General of the SCEL, gave the welcoming address. Maj. Gen. James D. O'Connell, Chief Signal Officer, was the principle guest speaker at the December 7 banquet. A Signal Corps wire and cable exhibit in the Berkeley-Carteret mezzanine was open during the three-day activities.

Chairmen of the various technical sessions, in addition to Mr. Kitts, all associated with the SCEL, were: M. Tenzer, chief, microwave transmission lines units; W. R. Krueger, chief, line facilities section; H. F. X. Kingsley, chief, field wire and cable section; and H. G. Gold, chief, special cable section.

A panel discussion on "A User's View of Plastic-Insulated Conductors in Outside Telephone Plant," on December 7, was conducted by engineers of Michigan Bell Telephone Co., including R. Foulkrod, W. M. Alexander, L. N. Dahl, and J. R. Kershaw.

A wide range of topics of interest to the rubber and plastics industries was covered by the invited speakers. Summaries of the plastics talks follow.

"Physical, Chemical and Electrical Properties of Marlex Ethylene Polymers." R. V. Jones, P. J. Boeke, and W. R. Clark, Phillips Chemical Co.

Marlex 50, the first of a commercial series of Phillips ethylene polymers based upon the polymerization of ethylene at low pressure, was discussed by the authors from the point of view of what was called striking improvements in the basic nature of ethylene polymers. The new Phillips process was said to be capable of producing thermoplastic resins having properties that range from soft, flexible polymers to the tough, high modulus Marlex 50.

"Improved Polyvinyl Chloride Insulation for 105° C. Service." H. L. Wuerth and B. W. Hodges, The B. F. Goodrich Chemical Co.

Six years ago Goodrich's Geon 8630 became the first vinyl compound to receive approval for appliance wire applications at 105° C. Further developments along this line proved valuable to new radio, television, aircraft, and military applications, the authors said, and to these high temperature properties were added low temperature properties, increased abrasion resistance, good insulation resistance after humidity cycling, and improved heat aging properties. Geon 8800 was developed incorporating all of these valuable properties.

"Progress in Air Dielectric Cables." E. J. Merrell, A. Laird McKean, and John Arbuthnot, Jr., Habirshaw Cable & Wire Division, Phelps Dodge Copper Products Corp.

Different types of semi-flexible air dielectric cable have been developed recently, among which, according to the author, are Styroflex cable. Styroflexible, Spirafil, and Foamflex. All of their designs incorporate a means of continuous axial support of the inner conductor, together with an aluminum tube, copper braid or corrugated metal outer shield. The characteristics and advantages of these cables were described.

"RF Power Ratings of Teflon Coaxial Cables." G. J. Mares and C. C. Camille, American Phenolic Corp.

Teflon was said to have found extensive use in the manufacture of coaxial cables in both the electronics industry and the Armed Services because of its ability to withstand temperatures as high as 250° C., a considerable increase over polyethylene materials. The authors conducted an investigation to dtermine the power ratings of currently-used Teflon dielectric cables after developing new measurement techniques.

"Polyethylene-Insulated Telephone Cables." A. S. Windeler, Bell Telephone Laboratories.

Formerly, multiconductor telephone cables have been insulated with paper, applied as a helical tape, or laid down directly on the conductor in the form of pulp. Recently, plastics and other polymeric materials have been studied as possible replacements for these cheap materials, and of these polyethylene has been selected as the most promising competitor because of its excellent electric properties, including low dielectric constant and power factor, high dielectric strength, impermeability to water or water vapor, availability, and reasonable cost.

"A User's View of Plastic Insulated Conductors in Outside Telephone Plant." R. Foulkrod, Michigan Bell Telephone Co.

Plastic insulated conductors were first installed in 1951 in the company's toll outside plant and in its exchange plant in 1952. Subsequently, the use of such insulation was extended to self supporting, sheathless facilities for use in rural and urban areas.

The history of such applications as toll cables, exchange cable, rural wire, urban wire, and video pairs were discussed and the advantages of these applications given. The author believes that plastic insulated conductors, although higher in construction cost than paper or pulp insulated conductors, made over-all operation of his company's plant better and cheaper.

"Measurement of Volume Resistivity of Plasticized Polyvinyl Chloride." C. E. Balmer and R. F. Conyne, Rohm & Haas Co.

The authors have developed a DC resistivity testing procedure which would yield results of practical significance.

A detailed description of the devised testing procedure was given. The procedure was shown to be relatively simple, requiring only a small amount of test compound, and giving good reproducibility of results. In addition, these volume resistivity results showed good correlation with insulation resistance results obtained in samples of insulated wire.

"Spiral Multicolored PVC Wire." Gerard de Senarclens, Swiss Insulating Works, Ltd.

This paper described some of the recently-achieved improvements in wire insulation used in telephone transmissions, especially in regard to distribution wires, switchboard wires, and certain cables. Most notable improvement is PVC insulation in permanent colors which permits rapid identification of the wires and their functions.

Problems connected with the use of PVC in insulation, such as discharge of hydrochloric acid during soldering of the wire, the difficulty of uniform dyeing, and the lack of resistance to light on the part of the pigments, were eventually solved by the proper selection of the right PVC, plasticizers, pigments, and stabilizers.

"Recent Developments in Polyethylene Insulating Materials." R. J. Lurie and J. A. Snyder, Bakelite Co.

The author compared the low pressure and high pressure polymers in terms of a wide variety of physical properties, such as specific gravity, melt index, brittleness index, stiffness in torsion, yield strength, and stress cracking resistance, as well as electrical properties. The low pressure polymer was shown to be more advantageous in such properties as improved low temperature behavior, better retaining of strength and stiffness at higher temperatures, and a lower degree of expansion. Electrical properties were about the same.

The low presure polymer was also said to be less conducive to stress corrosion cracking. Mechanical properties were also improved, such as greater tensile strength, higher durometer hardness, and better stress-strain characteristics. The new polymer was said to make an outstanding supplement to the presently-available polymers used for wire and service drop cable covering, and could probably expand the potential use of polyethylene as a jacketing material over lead. Vastly improved factors of safety for momentary overload or high temperature exposure were also seen for the low pressure polymer.

"General Properties of the New Super-Polyethylene." G. H. Sollenberger, Koppers Co., Inc.

The author compared the physical and chemical properties of super-polyethylenes with conventional polyethylenes, discussing such factors as heat resistance, low temperature impact, tensile strength, chemical and solvent resistance, permeability, rigidity, surface quality, color range, and processing.

Concluding, he asserted that the super-polyethylenes offer an unusual combination of properties, such as improved heat resistance, greater rigidity, excellent low temperature impact strength, high tensile strength, and excellent appearance. This combination of properties was seen to fill a long-outstanding need and was expected to complement other materials by broadening the entire spectrum of plastics application.

"Autogenous Extrusion." A. N. Gray, Western Electric Co., Inc.

Autogenous extrusion was defined as extrusion without external aid in the form of heating or cooling of the extruder during operation. This may be accomplished by first designing the screw of the extruder so that it will receive material at room temperature and through the power exerted by the drive of the screw, and to heat and condition the material so that it is ready for extrusion when it arrives at the exit end of the screw. A natural balance is thus established which is very stable, and output remains constant.

It was thought to be possible that some degree of autogenous extrusion could be accomplished with standard plastic extruders, but to take full advantage of all the virtues of the system, specially designed screws were deemed to be necessary. Drawings of the extrusion system were presented and the theoretical and practical implications discussed.

"Development of Weather-Resistant Vinyl Jackets." E. E. Griesser and W. T. Higgins, Bakelite Co.

A rapid method for the development of weather-resistant vinyl compounds based on an established correlation of accelerated vs. actual weather performance was proposed. The ingredients of a typical vinyl compound were examined in terms of this accelerated test, and predictions were made for actual weather resistance improvement through proper selection of the resin, stabilizer, fillers, and pigments.

Plasticizer choice was based on compatibility, oxidation stability, and volatility tests. Finally, a list of stable colorants suitable for use in outdoor applications was reported. The actual combining of the best of these ingredients as predicted by the accelerated test has resulted in a compound vastly improved in actual weather resistance, according to the authors. Comparative tests were made without pigmentation so that differences in base formula could be seen more rapidly, but actual outdoor service would include only properly pigmented materials.

Discuss Spray Paint Masks

A talk on "Color Decoration of Plastics by Use of Electro-Formed Spray Painting Masks," by H. E. MacArthur, Conforming Matrix Corp., featured the December 14 dinner meeting of the SPE Toledo Section, held at the Stork's Nest Restaurant with some 20 members and guests attending.

Mr. MacArthur described the production of precision electroformed masks from copper and nickel, and discussed the lip, plug, and block cut-out masks and their applications. The practical application of these masks to mass production coloring techniques for plastics was illustrated by a film which also showed the special tools, fixtures, and automatic spray painting machines used. In the question-and-answer period following the talk, it was brought out that multiple-cavity molds often require the use of separate masks, even when the cavities were made from the same hob, to meet the need for absolute fit in some painting problems. By the same token, it is necessary to control molding cycles and conditions very closely to insure reproducibility in part dimensions.

New officers of the Section were announced during the business session, as follows: president, F. B. Rosenberger, Barrett Division, Allied Chemical & Dye Corp.; vice president. R. E. Dunham, Owens-Illinois Glass Co.; secretary, D. R. Bowlin, Don R. Bowlin Associates; and treasurer, E. I. Faber, Conforming Matrix Corp. Newly elected to the Section's board of directors are Mr. Dunham; W. E. Fillmore, Owens-Illinois Glass Co.; Erik Kohler, K & M Machine Co.; and J. L. Bernard, Bernard, Engraving Co.

Discuss Marking of Plastics

The SPE Toledo Section concluded its recent series of programs on the decoration of plastics at the January 11 meeting. Some 33 members and guests of the Section attended the meeting, held at Lynn's Restaurant, which featured talks by Carl Johnson and Sumner Raymond, both of Markem Machine Co., on the machines, inks, and methods developed by the company for applying surface markings or designs to plastics.

The speakers began by explaining the general methods used for printing or decorating, including flat impact, rotary impact, stencil or silk-screen printing, and offset planographic. Research on inks was described in detail, with emphasis on the tailoring of an ink compound to a particular plastic substrate and performance requirements. The importance of the ink roll or plate composition as a factor in determining working life and drying time was also stressed. The talks closed with a showing of a film illustrating the use of Markem machines and decorating methods.

Section officers for 1956 were installed at the meeting, and the following committee chairmen appointments were announced: program, J. W. Hyland, Jr., Barrett Div., Allied Chemical & Dye Corp.; house, Bob Lowry; membership, G. H. Greifelt. Reliable Machine & Tool Co.; publicity, John Larimore; professional activities, J. M. Little, J. M. Little & Associates; credentials, D. R. Bowlin, D. R. Bowlin Associates; auditing, A. J. Gogel; educational, R. J. Obert, Barrett Div.; nominating, D. E. Cordier, Barrett Div., election inspection, G. R. Bennett, Beta Plastics Co.; and journal reporter, C. A. Richie, Owens-Illinois Glass Co.

Three Speakers at Newark

Following the custom of recent years, the first dinner meeting of the year for the SPE Newark Section was held jointly with the New York Section on January 11 at the Military Park Hotel, Newark, N. J. The technical program which followed dinner consisted of talks on different phases of plastics finishing by R. H. Stalbaum, F. J. Stokes Machine Co.; L. E. Parks, Logo, Inc.; and Irving Skeist, Skeist Laboratories.

Mr. Stalbaum spoke on vacuum metallizing, and emphasized the differences between the top coating and second-surface coating techniques. The vacuum metallizing process was described in detail, beginning with the parts being mounted on racks and lacquer coated by spraying, dipping, flow coating, or slow spinning. After baking the coating, usually for 1-2 hours at 150° F., the racks are placed in the metallizing chamber. For an aluminum metallized coating, aluminum staples are hung on the tungsten filament. After metallizing, a topcoat of lacquer is applied to the part and baked dry. This final lacquer coat can be colored to a desired color. Some of the newer developments in the field were described by the speaker as being the use of metallizing in printed circuitry, and the continuous metallizing of films.

Dr. Parks discussed the painting of plastics, and began by pointing out the differences between lacquers and enamels. Some of the problems in painting of plastics were described, including the need for proper color standards and consideration of surface design of the part.

Dr. Skeist spoke on cementing and laminating of plastics, stressing the influence of polarity on these processes. Rating the common plastics in polarity, we range from highly polar nylon to highly non-polar polyethylene and Teflon. Crystallinity ranges from the highly crystalline materials such as nylon and polyethylene to highly non-crystalline polystyrene. In general, the crystalline plastics are more difficult to bond.

Table favors were distributed through the courtesy of Jersey Plastics Co., and the meeting closed with the drawing for door prizes contributed by Hydraulic Press Mfg. Co. and Shaw Insulator Co.

Six Speakers at Milwaukee

The January 10 meeting of the SPE Milwaukee Section was designed to acquaint the members with local activities and the men involved in these activities of the plastics industry. As such, six companies from the Milwaukee area furnished speakers for the meeting. The speakers and their topics were as follows: "Plastic Parts from Molding Compounds," Paul Tills, Dickten & Masch Mfg. Co.; "The Use of Plastics in Adhesives, Coatings, Plastic Tooling, and Pipe at A. O. Smith," Art Raeuber, A. O. Smith Corp.; "Decorative Plastics by Vacuum Plating," W. H. Gobeille, American Motors Corp.; "Extruded Plastic Tubing and Sheeting," Eli Ostoich, Sunlight Plastics Co.; "Continuous Laminating of Polyester Resins," Fred Shaw, Continental Can Co.; and "The Applications of Plastisols," A. H. Kelch, A. H. Kelch Co.

Philadelphia Section Elects

The SPE Philadelphia Section held its annual dinner-dance on December 14 at Franklin Institute. A total of 129 members and their guests attended the function which was entirely social in nature, with table favors for all and the distribution of 65 door prizes.

Section officers for 1956 were announced as follows: president, Edward Fitzpatrick; vice president, C. H. Jepson, E. I. du Pont de Nemours & Co., Inc.; secretary, H. A. Fuggitti, Electric Storage Battery Co.; treasurer, S. H. Greenwood, F. J. Stokes Machine Co.; and national director, N. A. Skow, Synthane Corp. Newly elected to the Section's board of directors were E. C. Bernhardt, Du Pont; Herbert Clark; and John Johnson.

To Study Vapor Barriers

The Building Research Advisory Board announced the appointment by the National Research Council of an 18-man advisory committee to conduct an "examination and evaluation of the test procedures for and the installation of vapor barrier materials for use with slab-on-ground construction and as ground cover in crawl spaces." The study was proposed by FHA, and is scheduled for completion on or before May 31, 1956.

The committee held its first meeting in Washington on January 5-6, and has the following points under consideration: (1) a clarification of vapor barrier terminology; (2) the forces involved in migration of vapor and water in direction and potential magnitude; (3) an analysis of the basis for selection and design use intended for the various vapor barrier materials; and (4) a study of installation methods, such as handling, joints and laps, securing in place, and the use of base or fill materials.

T. S. Rogers, technical consultant for Owens-Corning Fiberglas Corp., is chairman of the committee.

NEWS of the INDUSTRY

Du Pont Plans New Orlon Plant

A project is under study at E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., for the building in Waynesboro, Va., of a large new plant for the manufacture of Orlon acrylic fiber. If authorized, the new plant will be in addition to existing extensive facilities there for making acetate yarns, and would have an annual production of 40-million pounds of Orlon. Results of the study are not expected for several months. At present, all Orlon is produced commercially at the company's plant in Camden, S. C., but main research work on the fiber is centered in Waynesboro.

New Vinyl Esters Unit on Stream

A new vinyl esters unit was scheduled to go on stream this month at the Niagara Falls, N. Y., plant of Carbide & Carbon Chemicals Co., New York, N. Y. This new unit will be the first to produce tank-car quantities of vinyl propionate, vinyl butyrate, and vinyl-2-ethylhexoate, and these larger quantities will result in lower prices by the company.

These three esters have been supplied by Carbide from a pilot plant for the past two years. Their manufacture in commercial quantities is the culmination of a development program initiated by the company over four years ago. Polymers based on the three esters are being used in the surface coatings, adhesives, oil additives, and vinyl sheeting fields. When copolymerized with several other ethylenic monomers, including vinyl acetate, acrylic esters, maleic esters, and vinyl chloride, they provide new materials for the plastics industry.

Goodrich Chem. Reviews 1955

John R. Hoover, president of B. F. Goodrich Chemical Co., Cleveland, O., cited the company's $5.5-million expansion program now under way and nearing completion as "reflecting our faith in the continuing growth and prosperity of this country." Substantially larger plans are on the drawing boards for 1956, he stated.

Goodrich Chemical plants involved in the current expansion were at Avon Lake and Akron, O., Louisville, Ky., Niagara Falls, N. Y., and Kearny and Haledon, N. J. The company's expansion blueprint is based on continued sales growth and the development of new products, Mr. Hoover said. He noted that an important step in the firm's integration of raw materials was completed last year when a new $9.5-million acrylonitrile plant began operating at Calvert City, Ky.

In discussing the company's associated chemical firms outside the United States, Mr. Hoover noted that British Geon, Ltd., and Japanese Geon, Ltd., increased their production of vinyl materials during 1955; Japanese Geon began construction of a new plant to double its capacity by the end of this year; Geon do Brasil and Geon de Mexico began full commercial production of vinyl resins in 1955; and Goodrich Chemical engaged in engineering a new $3.5-billion plastic plant for B. F. Goodrich Canada, Ltd.

Dow to Build New Latex Plant

A plant for the production of synthetic latex will be built at Pittsburg, Calif., by Dow Chemical Co., Midland, Mich. Construction will start at once, and the new plant is expected to be in production this fall. Estimated to cost in excess of $1-million, the plant will be capable of producing a broad range of styrene-butadiene latices which are widely used in the manufacture of paints, coated papers, and other products. Demand for these latices has been increasing steadily, and the new plant will facilitate Dow's services to West Coast customers. Similar latices are now being made by Dow at Midland, Velasco, Tex., and Sarnia, Ont., Canada.

Enters Plastics Field

The Jones-Dabney Resins & Chemicals Division is entering the plastics field as a basic supplier of epoxy resins, it was announced by J. M. Thomas, vice president of the Jones-Dabney Division, Devoe & Reynolds Co., Inc., New York, N. Y. A new laboratory has been established for technical service to the plastics industry. This laboratory will devote its entire time to the formulation of plastics compounds and the servicing of the industry. The marketing of epoxies and other resins is being done through the Resins & Chemicals Division, which is being expanded to accommodate this new activity.

The new technical service laboratory is headed by George V. Jenks, director of technical service, and Harold C. Cooke. In addition to assisting Mr. Jenks, Dr. Cooke will be concerned with the development of formulations. Mr. Jenks, formerly with Goodyear Aircraft Co., has had extensive experience in plastics tooling, laminating, adhesives, pitting, and encapsulating. Dr. Cooke has been with Pittsburgh Plate Glass Co., and for the past 10 years has been working on epoxy research for Devoe & Reynolds.

1956 Kelvinator washer has glass-reinforced plastic panel.

Uses Glass-Reinforced Panels

A fire-resistant fiberglass-reinforced plastic panel, molded by Duralastic Products Co., Detroit, Mich., is used in the 1956 Kelvinator deluxe automatic washer and deluxe dryer to provide a total enclosure for the wiring systems of the laundry units, thus permitting use of unshielded electrical connections. Approved by Underwriters' Laboratories after passing heat and insulation tests, the panels are the first to be used by Kelvinator in its laundry equipment.

The sparkling panels, which house the "Do-It-All" dials on the washer and dryer, are molded with white and red overlines forming a block pattern. The pattern is integrally laminated and virtually indestructible, fadeproof, resistant to scratching and breakage, and unaffected by soap, detergent, acid, or bleach.

New Plastics Molding Firm

Kennerley-Spratling, Inc., a new plastics molding firm, announced that production is under way at its new plant in Berkeley, Calif. The company is headed by Fred L. Kennerley, president, and Ernest N. Spratling, vice president. Both principals have had more than 25 years of experience in plastics, and have worked together for the past 12 years as general manager and plant superintendent, respectively, for American Molding Co. of San Francisco.

The new firm, which will be engaged in custom molding operations, plans to specialize in compression, transfer, and injection molding of nylon, polystyrene, polyethylene, acrylics, butyrates, acetates, fluorocarbons, alkyds, phenolics, and ureas.

New PVC Plant for Eleonora

A new polyvinyl chloride plant is being built for Eleonora Chemical Corp. in Passaic, N. J., it was announced by Hans Wyman, company president who also heads up the parent firm, The Pantasote Co., Passaic, N. J. The new plant, being built by Scientific Design Co., Inc., is scheduled to go into production before the end of this year, and will concentrate on the manufacture of PVC used by Pantasote for making vinyl film, drapery and upholstery sheeting, and coated fabrics.

To Build Titanium-Ore Plant

Metal & Thermit Corp., New York, N. Y,. has purchased an 800-acre tract near Montpelier, Va., as the site for a new plant for mining and processing titanium-bearing ore. Plant construction will start this spring and be completed in the fall. The project is expected to cost about $750,000, and the new plant will employ between 40-50 persons.

The plant will produce both rutile titanium dioxide and ilmenite. The latter, also known as iron titanate, is the basis of titanium pigments used in the plastics, paint, rubber, and other industries. The company formerly operated a rutile plant at Roseland, Va., through a subsidiary company. This mine was closed as the subsidiary liquidated in 1949.

Children's Market Aids Plastics

The children's market will play a large part in 1956 for the plastics industry, according to H. W. Wyman, president of The Pantasote Co., Passaic, N. J., who predicts that the retail value of plastic wallpaper alone will amount to at least $25-million annually. He also predicted a large increase in consumption of plastic tablecloths, shower curtains, draperies, and baby bottles. The rapid increase in our birth rate and our population will benefit that plastics industry, Mr. Wyman declared, especially those manufacturers who concentrate on children's goods, not only during the current year, but at least until 1961.

Plans New Kralastic Plant

Naugatuck Chemical Division, United States Rubber Co., New York, N. Y., has acquired a 150-acre tract of land in the Scott's Bluff region of Baton Rouge, La., on which the company plans to construct a new plant for the manufacture of Kralastic materials, copolymers of styrene, butadiene, and acrylonitrile. The new plant is expected to cost more than $5-million, and more than double productive capacity for these plastic materials. Construction will start immediately, and completion of the new plant is expected by July 1957.

Bassons To Double Facilities

Approximately 100,000 square feet of the former Alexander Smith Carpet Co. plant in Yonkers, N. Y., has been purchased by Bassons Industries, Inc., New York, N. Y., as part of its expansion plans for 1956. Operations in the present Bassons plant will continue and, with the addition of the new facilities, it is expected that present production will be more than doubled.

Occupancy of the new unit is scheduled for early spring. Bassons, a custom plastics fabricator, anticipates the biggest year in its history. Billings for the first nine months of the present fiscal year have already shown a 52% increase.

Bruce Stafford Studio, Inc.

New plant of Mayon Plastics in Hopkins, Minn.

Mayon Moves to Larger Plant

Mayon Plastics, formerly of Minneapolis, Minn., has occupied their new and larger building in Hopkins, Minn. Of modern steel and masonry construction, the new plant has 25,000 square feet of floor space, permitting a substantial increase in the firm's production facilities.

The company was established in 1946 to make vinyl tubing for industrial, farm, and home use. In recent years, Mayon has specialized in the manufacture of non-toxic food tubing which is also in general use in the drug, cosmetic, photographic, and printing industries.

Completes Expansion Program

A program of expansion involving plant, equipment, products, and services has recently been completed by Portco Corp.'s paper and plastic division, Vancouver, Wash. A designer and fabricator of custom-tailored bags, covers, and liners, the firm recently purchased the machinery and equipment of Central States Paper & Bag Co.'s Auburn, Wash., operation. This was transferred "in toto" to the enlarged Portco plant in Vancouver.

New products resulting from the installation of this modern machinery include polyethylene bags, covers, liners, and sheets in a full range of sizes and thicknesses; waxes and treated papers; and spirally-wound tubing tailored to meet specific requirements. Plant additions, which were completed in October, added 50,000 square feet of manufacturing area.

Polyethylene Liners for Steel Solve Packaging Problem

Polyethylene liners for steel containers have solved a long-term packaging problem for Cott Beverage Co., New Haven, Conn. The containers are used for shipping soft drink concentrates to the company's 22 franchised bottling plants. Although the more popular concentrates are shipping in 50-gallon barrels, the slower-moving flavors normally are shipped in smaller lots, usually in five-gallon containers.

Inspecting a JaLiner polyethylene plastic liner for steel shipping container.

The first five-gallon containers used by Cott were standard steel pails whose inner surfaces were coated with a phenolic-base liner, but it was found that the concentrates tended to dissolve some of this lining. Next, the firm tested a plastic bag liner, but this was unsatisfactory because the thin bags often broke in transit.

After research by Electronic Wave Products, Inc., New York, N. Y., and the container division of Jones & Laughlin Steel Corp., Pittsburgh, Pa., a heavy-gage polyethylene liner for steel containers was developed and put into use. Named the JaLiner, the plastic liner is claimed to be the first closed-top liner for steel containers that is an integral part of the container. Manufactured by Durethene Corp., Chicago, Ill., the liners are available in five-gallon shipping pails with rolled-on ring seal covers. Pouring fittings of polyethylene are available for the JaLiner.

Jones & Laughlin is developing JaLiners in one-, 10-, 15-, and 30-gallon sizes. According to Cott, the plastic liners solve "osmotic seepage" and all other container shipping problems. The company also reports that approximately 50% of its concentrates are shipped in JaLiner containers, and that the containers are received in ready-to-fill condition. The liners also have eliminated the "tainting" problem of contamination upon long-term storage.

Offer New Industrial Fiber

Commercial production of Fortisan-36, a super-strong cellulose acetate fiber, has been instituted by Celanese Corp. of America at its Rome, Ga., plant. Said to possess great strength, low elongation, and dimensional stability, the new fiber is expected to find applications in such fields as V-belts, power transmission belting, high-pressure hose, conveyor belts, truck tires, plastic laminates, oil hose, and tarpaulins.

Extrusion, saponification, washing, drying, and collection on eight-pound bobbins or parallel tubes are accomplished in a continuous operation using special spinning machines designed by Celanese. Equipment occupies three different floor levels to take advantage of gravity flow. Acetate "dope" is charged into the system on the third floor, and the finished yarn is ready for packaging on beams or cones at the first-floor level.

Covering 60,000 square feet of floor space, the Fortisan-36 equipment makes extensive use of automation and instrumentation. All instruments and controls are located on a graphic panel, from which vantage point the operator can start or stop any part of the process except the spinning machine. Temperature, flows, and concentrations of the more than 2,500,000 gallons of process fluids which pass through the system daily are easily adjustable.

Fortisan-36 is available initially in 800- and 1,600-denier continuous filaments. Other sizes in the heavy denier ranges will be offered at a later date.

Power Lathe Replaces Mandril

An electrically-driven lathe has been developed by Lunn Laminates, Inc., Huntington Station, N. Y., to replace the costly and time-consuming wax mandril method of molding reinforced plastic cylinders. Those produced by the older system had to be machined to the proper dimensions, melted down after one run, and rebuilt.

The Lunn-Lathe is said to feature ease of operation, longer life, and faster production runs. Moving at a controlled speed of one rpm., the unit is automatically fed various thicknesses of glass cloth by means of a tension arrangement from an adjoining rack. As the cylinder rotates, the cloth is impregnated with the resin. A routing attachment trims the projected cylinder to the desired size as it revolves.

After the cylinder has been cured, trimmed, and is ready for removal, a hydraulic jack lift is employed for the ejection. The correct ejection slot is selected automatically, and an eight by three-foot steel crane swings out, removing the cylinder intact.

Operated by a single rotary motor, the lathe requires only minor maintenance. Reinforced plastic cylinders varying in size from five inches to six feet in length, 2-10 feet in diameter have been produced.

Employ Fluorocarbon Coatings

Highly-corrosive chemicals in concentrated form have been shipped successfully in 4,050-gallon highway tank-trailers which were coated with Kel-F fluorocarbon dispersions. Developed by M. W. Kellogg Co., Jersey City, N. J., the coating was applied to the inside of a 33-foot Trailmobile tank-trailer in one of the largest furnaces ever built for experimental coating use.

Measuring 36 by 12 by 12 feet, the oven accommodates equipment up to 10 feet in diameter. A recirculating type, the oven is propane gas-fired and can be heated up to 520° F. in one hour. The total Btu. rating is 3½-million; however, the oven can be divided into two separate zones, each capable of producing 1,750,000 Btu's.

Baking reportedly produced a tough, adherent coating with 400° F. temperature resistance, low temperature flexibility, chemical resistance, low-moisture permeability, and high dielectric strength. The dispersions themselves consist of 1-20 micron particles suspended in volatile organic liquids. The addition of wax improves cohesion and adhesion of the air-dried particles to supporting surfaces, and promotes rapid fusion of the particles into a continuous film. Two major types of Kel-F dispersions are available, both supplied at 40% solids.

The dispersions have a high-gloss appearance, and can be applied by spray, dip, or by spreading. Production-wise, these coatings are flexible enough to be applied to metals in the flat before forming.

Lummus Co.'s new engineering center.

Develpoment Center Planned

An engineering development center will be established this year in Newark, N. J., by the Lummus Co., New York, N. Y., designing engineers and constructors for the petroleum and chemical industries. For this purpose, the company has purchased a 150,000-square foot building on a 10½-acre plant near the Newark Airport. Lummus, which has had similar facilities in Bayonne, N. J., for the past 25 years, will use the new building primarily for pilot plant operations and process development work carried out in conjunction with its clients.

Plastic Tooling Offers Savings

"Plastic tools and dies permit savings up to a quarter of a million dollars in a single phase of automotive production by reducing the number of tooling operations," according to Frank L. Bogart, Marblette Corp. sales engineer, in a talk delivered at the tenth annual technical convention of the American Society of Body Engineers. Time and labor savings achieved through the rapid fabrication, light weight, and durability of plastics have reportedly led to their use in the establishment of trim lines and contours as well as complex production tools.

One example cited was the reduction in the number of stamping operations required for automobile tail lights from nine to five. In addition, short-run stampings were made on plastic dies with less servicing than would be required to "spot-in" a metal tool. In other instances, Chrysler Corp. empolyed phenolic dies to produce prototype automobile panels; Fisher Body has made use of stretch dies and other tools cast from a self-curing epoxy with a low-cost foam core; and Ford has utilized plastic dies to determine the practicability of unusual designs.

Among the increasingly common applications for plastic tooling, Mr. Bogart included contour checking gages, drill fixtures, hole checking gages, assembly fixtures, buffing fixtures, and paint spray masks. For heavy-gage work, Marblette is testing a core resin of high compressive strength which offers considerable promise in casting dies without a laminate for short runs of 0.03-0.04-gage steel. Other predictions for the coming year made by Mr. Bogart were as follows: non-toxic hardeners for epoxy resins; an epoxy foam curable at room temperatures; stable phenolic board which can be machined with wood-working tools; non-sagging troweling and splining resins; and metal-filled epoxies for casting.

Hooker Absorbs Niagara Alkali

A certificate of consolidation filed with the New York Department of State officially merged Niagara Alkali Co., Niagara Falls, N. Y., into Hooker Electrochemical Co., also of Niagara Falls. Action followed a favorable vote by stockholders of both companies.

J. Clark Cassidy, former president of Niagara Alkali, was elected a vice president and director of Hooker at the first meeting of the consolidated board of directors. The firm itself will be operated as the Niagara Alkali Division of Hooker. Its assets of some $12,000,000 bring the parent organization's assets to more than $100,000,000.

Campco Urges Sheet Standards

Thermoplastic sheet manufacturers were urged to set up standard tests for sheet stock by Edward F. Bachner, Jr., vice-president of Chicago Molded Products' Campco Division, in a recent speech before the Sheet Forming Division of the Society of the Plastics Industry. "Quality standards are neither practical nor desirable," he stated, "however, uniform tests would indicate to the user what he might expect in the way of fabrication or in a specific application."

Lacking industry-wide specifications, fabricators have been called upon to supply sheets conforming to previous lots or samples. This negates the possibility of change in source required by delivery dates or other considerations. Areas particularly in need of such specifications were felt by Mr. Bachner to be surface finish, strain pattern, surface hardness, abrasion resistance, impact strength, and standard sizes.

Establish Joint Operation

Metal & Thermit Corp., New York, N. Y., and United Chromium of Canada, Ltd., Toronto, Ont., will combine their Canadian activities under the name of Metal & Thermit—United Chromium of Canada, Ltd. A new office, warehouse, and plant facilities will be constructed in Toronto to house the joint operation. These facilities will be erected on a recently-purchased four-acre site in the northwest section of Toronto.

Products sold in Canada by Metal & Thermit include Themolite stabilizers for vinyl plastics, Ultrox zirconium opacifiers, Murex welding electrodes, and others. United Chromium products include plating solutions, rack coatings, and a line of maintenance finishes and coatings. The joint operation is expected to materially increase Canadian business operations.

The new company will be under the local management of James Guffie, former manager of United Chromium. Other officers of the joint operation are H. E. Martin, president; C. J. Beasley, vice president and treasurer; H. D. McLeese, vice president; E. F. Hutt, office manager; and J. F. Condon, secretary.

Adipic Acid Plant Being Built

Construction has begun at Luling, La., on a new plant for large-scale production of adipic acid, representing a major expansion in the product by the organic chemical division of Monsanto Chemical Co., St. Louis, Mo. Located at the Barton plant of Lion Oil Co., a Monsanto division, the new unit is estimated at several million dollars in cost and is expected to be on stream early next year.

The new plant will be fully integrated with Lion raw materials facilities at the location. Monsanto has been one of the major domestic suppliers of adipic acid since January 1955, when the company first offered the resin intermediate in commercial quantities. Long used in the manufacture of nylon, adipic acid has come into rapidly expanding use in the making of flexible polyurethane foams, as a modifier for surface coating resins, and to impart added flexibility to vinyls and polyesters. The chemical also is used in the manufacture of synthetic lubricants, detergents, and textile chemicals.

Outlook for Chemical Construction in 1956-57; Report for 1955

An estimated $1.6-billion will be spent on new chemical construction during 1956-1957, according to a recent survey by the Manufacturing Chemists' Association, Inc., Washington, D. C. The survey also disclosed that privately-financed chemical construction projects completed during 1955 totaled $772-million.

The survey covered 599 projects, 269 of which were completed last year. The 246 projects now under construction will cost an estimated $1.1-billion, while there are 84 projects definitely committed which will cost an estimated $507-million. The total of projects completed in 1955, plus those under construction or definitely committed for completion within the next two years, reaches $2.3-billion.

More Chemical Industry Firsts

"The chemical industry far exceeds all others in the magnitude of its basic research program," according to the National Science Foundation in its report on science and engineering in American industry. Estimated at $38-million, the chemical industry's expenditure represented 25% of the total amount spent on basic research by all industry in 1953. Applied research and development outlay totaled $323.1-million, bringing the total cost for all chemical research to $361.1-million.

The chemical industry likewise led all industry in the number of scientists and engineers employed. As of January, 1954, there were 62,700 under active employ, or one in 12 of the total number of persons employed in the chemical industry. A further breakdown shows 26,000 engineers and 23,400 listed as chemists.

Artist's conception of Polyplastex United's new plant in Union, N. J.

Announces Expansion Plans

Polyplastex production is expected to triple when the new, Union, N. J., plant goes on stream next month, according to official sources at Polyplastex United, Inc., New York, N. Y. The unit will house the firm's general offices, design department, and research division, as well as production facilities.

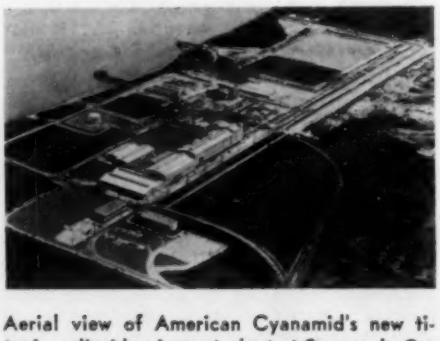
Full capacity should be reached within three months after the opening date, after which time the old Bronx, N. Y., factory will be vacated. Polyplastex recently completed its tenth year of operations in the field of decorative plastic laminates, and found its existing facilities inadequate to meet existing demands.

In conjunction with the New Jersey plant, the company will continue to operate its factory in St. Petersburg, Fla., and will maintain its showrooms and offices in New York City and Chicago, Ill.

Cyanamid Opens Pigment Plant

A $15-million plant for the production of titanium dioxide pigment was recently dedicated by American Cyanamid Co., at Savannah, Ga. Located on a 1,600-acre tract, the new unit had been under construction since 1953. It represents the 49th production facility erected by Cyanamid, and operation will be under the firm's pigments division.

Titanium dioxide reportedly is the whitest pigment yet discovered though, curiously enough, the basic raw material is derived from black titanium-bearing ore. Applications are found in the paint, paper, plastics, and rubber industry for such everyday items as kitchen appliances, white-wall tires, dinnerware, and golf balls.



Aerial view of American Cyanamid's new titanium dioxide pigment plant at Savannah, Ga.

Forms Plastics Laminate Firm

A new plastics corporation which will specialize in the production of high-pressure decorative laminates has been founded in Temple, Tex., under the name of Ralph Wilson Plastics, Inc. First of its kind in that State, the firm was organized by Ralph Wilson, who will serve as president and general manager. Mr. Wilson was the founder of Wilson-Hoppe Plastics Co., Los Angeles, Calif., which was sold to Eagle-Picher in April of last year.

An eight-acre site was chosen for the new plant. Production is scheduled to begin March 1, and capacity is estimated at 1,500,000 square feet per month. The building occupies 50,000 square feet, and will house 150 employes. Advance orders in excess of $1-million have already been secured.

In Brief . . .

Micro Switch, a division of Minneapolis-Honeywell Regulator Co., has purchased a multi-story factory building in Freeport, Ill. The firm had been occupying space in the 300,000-square foot facility on lease arrangement from Henney Motor Co.

Jesse S. Young Co., New York, N. Y., has been formed to act as sales agents in the New York metropolitan area for manufacturers of chemicals and machinery for the plastic, paint, rubber, printing ink, and allied industries. Among the firms represented by Young are Advance Solvents & Chemical Corp., Resyn Corp., and Troy Engine & Machinery Co. Jesse H. Young, president of the new company, was formerly assistant to the president of Advance Solvents, dealing with the sales and technical sales divisions.

Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y., has announced the opening of a new sales office at 233 Saint Maurice Ave., New Orleans, La.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has licensed Eastman Kodak Co., to manufacture polyester photographic base and film under Du Pont patents. The material has been trademarked Cronar.

Houze Glass Corp., Point Marion, Pa., has undertaken the development of an improved glass fiber for reinforcing plastic materials under a research and development contract with the Navy Department, Bureau of Ordnance. The project will be directed by Albert H. Lasday, formerly of Preston Laboratories.

(Continued on page 134)

News from Abroad

German Plastics, 1955

To meet the greatly increased demand at home and abroad, German producers of plastics undertook large expansion programs which resulted in further increase in output of plastics in the first half of 1955 to over 198,000 tons, or 30% above that of the same period the year before. Since some of the programs still have to be completed, the second half of 1955 is expected to show a still higher rate of production bringing the total for the year to well over 400,000 tons.

Greatest advances were made in polymerization plastics for which the total of some 93,000 tons was 35% above that for the first half of 1954. In this field, PVC progressed most rapidly and total output in 1955 is expected to be about 100,000 tons, or double that in all of 1954. Polyethylene would figure among the 1955 plastics, since large-scale production was planned for the last quarter of the year. Condensation products at 80,435 tons showed an increase of not quite 30%, in which phenol-cresol resins, polyamides, polyurethanes, and silicones were largely responsible.

German manufacturers also sold much more plastics (including film) to European countries in the first half of 1955. Overseas trade proved disappointing mainly because the two most important South American countries, Argentina and Brazil, took only negligible quantities. This reverse increased business with other overseas territories, especially in Asia (some 50% higher). Total exports of plastics (including film) came to 39,532 tons valued at 138,524 D.M., an increase of about 46% in quantity and 37% in value over the first half of 1954.

Exports of plastics manufactures came to 3,138 tons valued at 48,320,000 D.M., a rise of 60% in volume and of just under 37% in value.

Plastics in France

The French plastics industry has developed rapidly during the years following World War II; however, France still ranks fifth behind the United States, Germany, Great Britain, and Japan in total production figures. Approximately 75,000 metric tons were produced in 1954, two-thirds more than the previous year's output. Consumption during the same period rose from 58,000 to 85,000 tons, an increase of 47%.

Though France still must import special resins, she has become an exporter of cellulose acetate, PVC, polystyrene, polyamides, and phenolics. During 1954, 18,800 tons of plastic material valued at $17-million were imported, and 8,100 tons of material valued at $9-million were exported.

The United States supplied for 30%, by value, of French imports during that period; other important sources of supply being Canada, West Germany, Great Britain, and Italy. Foreign customers for French materials were Switzerland, Belgium-Luxemburg, Great Britain, Argentina, West Germany, and China.

Finished articles were produced by some 2,500 enterprises. Though higher in price than foreign produced articles, due to a condition which exists throughout French industry, French products are protected by government duty exemptions and credits. Quality standards are being developed through industry-governed collaboration.

Producers of resins and semi-processed materials are organized in a professional association known as the Syndicat Professional des Fabricants de Matieres Plastiques et des Resines. Processors are grouped together in the Union des Syndicate de la Transformation des Matieres Plastiques, which is actually a federation of primary associations based on end-products. The plastics industry is centered mainly in Paris, Lyon, Oyannax, and Miru. Fairs and expositions have been held periodically in Paris, Lille, and Lyon.

Plastics in Finland

Production of plastics in Finland is small, but reportedly on the increase. Outputs for 1952-54 are given in the following table:

	Production, metric tons		
	1952	*1953*	*1954*
Phenolic molding powder	305	291	580
Urea molding powder	17	18	25
Melamine molding powder	10	15	30
Casein plastics	95	63	114
	427	387	749

Consumption of plastics by Finland's molding plants during 1954 is reported as follows: phenolic, 600 tons; urea resins, 260 tons; melamine resins, 105 tons; cellulose acetate, 170 tons; polystyrene, 380 tons; polyethylene, 350 tons; polyvinyl chloride, 1,230 tons; and plasticizers, 625 tons. All in all, there are about 80 molding plants operating in Finland.

British Plastics Sales, 1954

Sales of plastics materials by the British manufacturing industry in 1954 are shown in the tabulation below. The figures are for net sales only, calculated by deducting the costs of materials purchased from other firms in the industry from the total sales figures. For example, phenolic resins are not included if they have later been processed into molding powders; neither are vinyl resins if they subsequently have been compounded. Sales of plastic materials for further processing by firms outside the industry (such as for making paints, cables, etc.) are included.

Thermosetting materials:	
Alkyds: Solids and liquid resins	30,620
Other	3,098
Aminoplastics: Solids, liquid resins, and solutions	23,904
Molding and extrusion cmpds.	19,060
Casein plastics	2,096
Phenolics and cresylics: Unmodified resins	12,802
Modified resins	5,254
Molding and extrusion cmpds.	27,567
Sheet, rod, tube, profiles	14,785
Solutions, emulsions, dispersions	1,745
Other materials	1,663
Total thermosetting	142,594
Thermoplastic materials:	
Cellulose plastics: Molding and extrusion cmpds.	6,666
Other	4,537
Vinyl chloride: Molding and extrusion cmpds.	29,320
Sheets up to 0.012-in. thick	5,019
Other sheet, rod, tube, profiles	7,892
Solutions, emulsions, dispersions	2,011
Polystyrene: Molding and extrusion cmpds.	20,909
Other	486
Other thermoplastics	54,678
Total thermoplastic	131,518
Total	274,112

A listing of British net sales of plastics materials for the years 1950-1954 is given in the following tabulation:

	Thermosetting Materials	Thermoplastic Materials	All Plastic Materials
1950*	105,000	50,000	155,000
1951*	130,000	65,000	195,000
1952*	110,000	70,000	180,000
1953*	110,000	100,000	210,000
1954	142,594	131,518	274,112

* Estimated.

NAMES in the NEWS

Arthur Johnson

Donald H. Dalbeck

Donald H. Dalbeck has been elected president of Reed-Prentice Corp., Worcester, Mass., and of Package Machinery Co., East Longmeadow, Mass. Reed-Prentice is a wholly-owned subsidiary of Package Machinery. **Mr. Dalbeck** will also continue to serve as treasurer of both firms. Other elections announced by the companies were: **Roger L. Putnam, Jr.,** controller and secretary of Package Machinery assumes this position for Reed-Prentice; **J. Joseph Kelly,** vice president in charge of sales, has been elected to the board of directors of Reed-Prentice; and **Iver G. Freeman,** vice president of engineering and research, named chairman of the Reed-Prentice management committee.

Thomas E. Moffitt and **R. Wolcott Hooker** have been made executive vice president and senior vice president, repectively, of Hooker Electrochemical Co., Niagara Falls, N. Y. **Mr. Moffitt** was also elected a director of the company. He previously was vice president in charge of western operations for Hooker. **Mr. Hooker** formerly was vice president, director, and a member of the finance committee of the firm's headquarters office.

Walter G. Cox has joined the reinforced plastic division of Brunswick-Bakle-Collender Co., Marion, Va., as a design engineer in the project group. He was formerly associated with the electronics department of Glenn L. Martin Co., and has an extensive background in radome design.

Howard Luke has been named plant manager for Tech-Art Plastics Co., Morristown, N. J. He has been with the firm since 1948 in various engineering, sales, and management capacities.

Carl H. Bagen has been promoted to the position of manager of technical sales for Kaye-Tex Mfg. Corp., Yardville, N. J.

Richard A. Singer has joined the plastics division of Nopco Chemical Co., Harrison, N. J., as assistant sales manager in charge of Nopcofoams, the firm's new line of flexible urethane and vinyl foams. He will assist in the development of a distributor organization to handle nationwide sales.

A. P. Moss has been appointed industrial chemicals production manager for Carbide & Carbon Chemicals Co. He had been serving as chemicals and resins superintendent at the South Charleston, W. Va., plant. **Max Hill** has been named fine chemicals production manager, having previously served as assistant to **Mr. Moss. W. W. TenEyck** replaces **Mr. Moss** at the South Charleston plant.

Merrill H. Weymouth

Robert E. Reinker

Merrill H. Weymouth has been appointed manager of Dow Chemical Co.'s Hanging Rock plant near Ironton, O., and **Robert E. Reinker** assumes management of the Riverside plant, Pevely, Mo. **Mr. Weymouth** has been serving as superintendent of cellulose products for Dow's plastics production department. **Mr. Reinker** was technical advisor to the president of Asahi-Dow, Ltd., and more recently has been economics engineer for the plastics production department.

Ormond R. Gillen and **F. Joseph Triggs, Jr.,** have been added to the sales staff of Goodyear Tire & Rubber Co.'s chemical division as sales service staffman and sales trainee, respectively. The former rejoins Goodyear after 24 months of military service.

Ernest D. Carmagnola has joined Samuel B. Eppy & Co., Jamaica, N. Y., as mold engineer and industrial designer. Formerly mold engineer for Brilhart Corp. and Plastic Molded Arts Corp., he will be concerned with Eppy's new injection molding, vacuum forming, and vacuum metallizing operations.

H. A. Voskamp, Jr.

H. A. Voskamp, Jr., formerly manager of Barrett thermoplastic sales, has been named to the newly-created position of assistant manager of molding compound sales for Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. This personnel change is part of the company's reorganization of its sales and marketing structure for its new thermoplastic products. Barrett thermoplastic sales will henceforth be coordinated with the firm's operations in thermosetting plastics under the direction of **Henry W. DeVore,** manager of molding compound sales.

P. D. Shollar and **J. F. Haley** have been appointed departmental vice presidents of Koppers Co., Inc., Pittsburgh, Pa. Mr. **Shollar** had been serving as manager of procurement; **Mr. Haley,** as manager of traffic and transportation.

Joseph E. Nolan has been appointed to the technical sales department of Glyco Products Co., Inc., New York, N. Y. Formerly with Westvaco, **Mr. Nolan** has been assigned to the New England sales territory and will be based in Worcester, Mass.

James B. McCord has been added to the sales staff of the Chicago office of Plasteel Products Corp., Washington, Pa. He has more than 10 years of experience in the building products industry, having recently been in sales of insulation materials.

Frank H. Williams has been appointed Chicago sales representative for General Tire & Rubber Co.'s recently formed flooring division. He was the dealer sales manager for Walter E. Selck & Co.

M. H. P. Morand

M. H. P. Morand has been advanced to the post of manager of coatings sales for Dow Chemical Co., Midland, Mich., succeeding **Floyd J. Gunn** who has become manager of the company's Los Angeles, Calif., office. Since joining Dow in 1949, **Mr. Morand** has served in coatings sales and technical service, and became assistant to the coatings sales manager in 1953.

John F. Snyder, Sr., director and vice president of Hooker Electrochemical Co., Niagara Falls, N. Y., has assumed wider responsibilities in over-all company management. Formerly concerned with the Durez Plastics Division, he joins the administrative group at Hooker's headquarters offices. **Jay C. Searer** and **Lother A. Sontag** have been promoted to production manager and technical manager, respectively, for the Durez Plastics Division. **Dr. Searer** has been serving as director of industrial resins research, and **Mr. Sontag** was director of molding compound research.

John T. Moynihan has been appointed basic research supervisor for Acheson Dispersed Pigments Co., Philadelphia, Pa. He was previously associated with the National Bureau of Standards and Underwood Corp.

Richard A. Knight has been appointed assistant to the general manager of National Research Corp.'s equipment division, Newton Highlands, Mass. Former assistant manager of the sales department, he will coordinate the activities of the sales, engineering, and production departments.

Jack Weiss

Jack Weiss has been named vice president of Catalin Corp. of America, New York, N. Y. He joined the organization shortly after its founding in 1931, and has served as special accounts executive for the sales department.

H. Thomas Hallowell, Jr., president of Standard Pressed Steel Co., Jenkintown, Pa., has been elected president of the American Standards Association for a one-year term. Van H. Leichliter, vice president of United States Steel Corp.'s American Steel & Wire division, will serve as vice president for a similar term.

Edward H. Miller and **James W. Flynn** have been appointed manager of sales development and assistant general sales manager of the plastics division, respectively, for Celanese Corp. of America, plastics division, New York, N. Y. **Mr. Miller** joined the old Celluloid Corp. in 1926, and was named eastern district sales manager for plastics products by Celanese in 1941 when it was merged with Celluloid. Since then, he was director of sales for Celanese molding materials, and became assistant treasurer of the company in 1951. **Mr. Flynn** joined Celanese in 1943, has served in various research, sales, and marketing positions, and was director of sales for acetate sheet and molding materials prior to his new appointment.

Frank A. Magno

Charles R. Schroth

Charles R. Schroth and **Frank A. Magno** have been appointed assistant manager and technical representative, respectively, for the special blacks division of Godfrey L. Cabot, Inc., Boston, Mass. **Mr. Schroth** will be in charge of sales of special blacks in the eastern section of the country, except for New England. **Mr. Magno** will handle technical service on the special blacks in the midwestern area of the country.

John V. Reilly and **Martin H. Smith** have been appointed sales representatives for Baker Castor Oil Co., New York, N. Y. Formerly a salesman for Wallace & Tiernan's Harchem division, Mr. Reilly will service New York State with the exception of Staten Island and Long Island. Broiklyn, Queens, and Long Island will be covered by Mr. Smith, who previously served as technical sales representative for Atlas Mineral Products Co.

James D. Russell has been elected vice president and general manager of Young Brothers Co., Cleveland, O., makers of engineered ovens for industrial applications. He has been with the company since 1946.

William H. Spratling has been appointed to the new post of assistant director of purchases for United States Rubber Co., New York, N. Y. A graduate of Annapolis, he joined the firm in 1947 as a trainee buyer, and became a buyer of machinery and metals after three months. Since then, he has held other buying posts in the purchasing department, dealing with textiles, rubber, and packaging materials.

B. R. Krashin

Barnard R. Krashin has been appointed president of Colton Chemical Co., Cleveland, O., a division of Air Reduction Co., Inc. One of the organizers of Colton and previously vice president in charge of sales, **Mr. Krashin** succeeds **H. S. Colton** who resigned the company presidency to devote more time to personal affairs.

Earl Kochersperger has been appointed eastern regional sales manager of coated fabrics for United States Rubber Co., New York, N. Y. With the company since 1940, he will be responsible for sales of all Naugahyde vinyl upholstery in the eastern seaboard states.

W. M. Anderson and **J. K. Marshall** have been named district managers of the New York and Cleveland districts, respectively, for Carbide & Carbon Chemicals Co., New York, N. Y. **Mr. Anderson** had previously been manager of the Cleveland district, while **Mr. Marshall** had been acting manager of the New York district.

OBITUARY

S. D. Douglas

Dr. S. D. Douglas, senior scientist in the research department of Carbide & Carbon Chemicals Co., New York, N. Y., died on January 15 at Houston, Tex., after a long illness. Dr. Douglas was one of the foremost researchers in the field of plastics, and was responsible for many developments in vinyls. He joined Carbide & Carbon in 1926, after receiving a Ph.D. in chemistry from the University of Pennsylvania, and was appointed assistant director of research for the company in 1944.

Harold S. Kendall

Harold S. Kendall, assistant to the president of Dow Chemical Co., Midland, Mich., since 1941, died at his home in that city on January 9, following a long illness. Born April 14, 1893, in Marienville, Pa., he received his bachelor's degree from Grove City College, Grove, Pa. He was also graduated from Case Institute of Technology, Cleveland, O., with a B. S. in chemical engineering.

Mr. Kendall had been associated with the company since 1917, serving as analyst, plant superintendent, director of labor relations, and at the time of his death, was a member of the finance committee and secretary of the Midland division operating board. He was also a director of Brazos Oil & Gas Co., a subsidiary, until its recent merger with Dow.

Mr. Kendall was 62 years old. He is survived by his wife, two sons, and three brothers.

Keith H. Williams

Keith H. Williams, 30, plastics molding materials salesman with Dow Chemical Co.'s Chicago office, died December 11 in a Mendota, Ill., hospital of injuries received in an automobile accident near that city on December 4. Burial was in Marion, O., his birthplace.

Mr. Williams was graduated from Ohio State University with a B. S. in marketing. He joined Socony Vacuum Oil Co., serving three years prior to joining Dow in 1952. He leaves a wife and son.

New Materials

Write item numbers on Readers' Service Card to obtain more information.

Liquid Modified Epoxy Resin

A liquid, modified epoxy resin identified as Epocast 13 has been introduced by Furane Plastics, Inc. The material is said to have an eight-day pot life, a particularly useful feature in electronic impregnation and potting operations which require numerous pours.

During pre-gelation, resin viscosities are rapidly reduced with the increased temperatures required for cure. No amine hardeners are employed, and the material is relatively toxic-free. Epocast 13 may be purchased in preweighted kits for easy volumetric mixing.

Property data is as follows:

Cure cycles @ 250°F., hrs.	2
At 200°F.	5
Heat distortion temperature, °F.	135-140
Gel time, 30 gms. @ 250°F., min.	17
At 200°F., min.	80
At 150°F., hrs.	15
Initial viscosity @ 80°F., cps.	1,500
At 160°F., cps.	120
Viscosity after 24 hrs. @ 80°F., cps.	2,000
After 48 hrs., cps.	2,600
Hardness of cured resin, Barcol Impressor GYZT934-1	10
Barcol Impressor GYZT-935	70
Dielectric constant @ 1 Kc.	4.5
At 110 Kc.	2.8
Power factor @ 1 Kc.	0.017
At 110 Kc.	0.012

Readers' Service Item M-1

Metal-Plastic Mold Material

Devcon C, a combination of approximately 80% aluminum and steel and 20% plastic, is being offered by Chemical Development Corp. for making low-cost molds for plastics, rubber, and allied materials. The metal-plastic material is heat-resistant, and can be poured or formed into any shape.

Said to be extremely tough, the new material is light in weight and similar to aluminum in many respects. Devcon C is reported to have very good heat resistance; a compressive strength of over 5,000 psi. at 400° F.; and practically no shrinkage or distortion during hardening. Once hard, the material can be drilled, ground, threaded, or machined with regular metalworking tools. When quick heating or cooling of the molds are desired, a small coil for steam or cold water can be imbedded in the material before it hardens. A special hardening agent is supplied with each container of Devcon C, for addition prior to pouring or forming.

Now being used for making plastic and rubber molds, embossing dies, tools, jigs, and fixtures, the material provides for the rapid manufacture of low-cost molds and other parts requiring high strength at elevated temperatures. In making a mold, a model of wood, plaster, or similar material is made, and the Devcon C poured and formed around the model. When hardened, the mold will reproduce all details on the model.

Devcon C is available in one-, four-, and 15-pound containers, and is said to have a practically unlimited storage life. Trial packages can be purchased containing four one-pound cans of Devcon C, four cans of the hardening agent, a supply of special release agent, and complete instructions.

Readers' Service Item M-2

Pure Methyl Vinyl Ketone

Pure methyl vinyl ketone, an extremely reactive monomer and chemical intermediate used in the manufacture of plastics and adhesives, is presently available in five- and 55-gallon drums from Chas. Pfizer & Co., Inc. A colorless liquid, the material reportedly shows no property changes after storage for several weeks at 30° C.

Chemically, methyl vinyl ketone functions as a diene which can be polymerized in bulk by heating with a peroxide catalyst. Polymerized in the vapor phase, it yields insoluble polymers. In solution or in aqueous media, it yields a latex. Copolymerization has been reported with acrylamide, acrylonitrile, butadiene, ethylene, methyl acrylate, styrene, vinyls, and vinylidene.

Following is a list of physical properties and specifications reported for the material:

Molecular weight	70.08
Odor	Very irritating
Boiling point, 760 mm., °C.	81.4
At 120 mm., °C.	32
Refractive index at 25° C.	1.4084
Density	0.8393-0.8636
Assay, carbonyl, %	97-103
Water content, Karl Fischer method, %	1
Hydroquinone content, %	1

Readers' Service Item M-3

Phenolic Molding Compounds

Two new compounds have been added to Synvar Corp.'s line of phenolic molding materials. Designated Synvars PM-6599 and PM-6449, the compounds are woodflour-filled and are colored black and brown, respectively.

Both materials are recommended for compression and transfer molding, and are available in a full range of flows. General-purpose in type, they are reportedly characterized by extremely fast curing speed and high-gloss surface finish.

Molded specific gravity of PM-6599 is reported to be 1.33-1.35; that of PM-6449, 1.41-1.43. Other properties and molding conditions for the two compounds are identical, and are listed as follows:

Granulation, mesh	16
Bulk factor	2.4-2.7
Molded shrinkage	0.005-0.007
Heat distortion point, °F.	290
Water absorption, max., %	0.5
Tensile strength, psi	6,500
Flexural strength, psi	9,000
Compressive strength, psi	30,000
Impact strength, Izod, ft.-lbs.	0.26
Dielectric strength, short-time, volts/mil.	300
Step-by-step, volts/mil.	200
Dielectric constant @ 1,000 cycles	7
Power factor @ 1,000 cycles	0.07
Compression molding temperature, °F.	280-350
Transfer molding temperature, °F.	280-350
Compression molding pressure, psi	2,500-5,000
Transfer molding pressure, psi	8,000-12,000

Readers' Service Item M-4

Intermediates for Resins

Two new compounds, pyromellitic acid (PMA) and pyromellitic dianhydride (PMDA), are in small-scale production by the explosives department, E. I. du Pont de Nemours & Co. Each compound has a symmetrical, tetrafunctional, aromatic structure, and is expected to prove highly versatile in a wide variety of uses where polybasic acids are required. Their unusual functionality offers opportunities for use in new cross-linking reactions, the preparation of multi-substituted derivatives, and new polymer configurations. Their substitution for acid intermediates in existing applications provides a means of obtaining interesting and useful product modifications.

Pyromellitic acid (1,2,4,5-benzenetetracarboxylic acid) permits significant changes in the acid functionality of an alkyd resin system, although it is not suitable for use as the sole non-fatty acid in glyceride alkyds. PMDA can be used to replace part of the organic anhydride used as a curing agent for epoxy resins, giving significant improvements in the properties of the fin-

shed resins, particularly at elevated temperatures. Di- and tetra-esters prepared from PMA or PMDA and unsaturated alcohols can be used to make unsaturated polyesters. Several tetra-esters of PMA have shown promise as plasticizers for vinyls.

Both new compounds are furnished as white powders, and have the following properties:

	PMA	PMDA
Molecular weight	254.15	218.12
Melting point, °C.	257-265	286
Boiling pt. at 760 mm., °C.	.....	397-400
Bulk density, lbs./cu. ft.	34	41
Neutralization equivalent	63.54	54.53

Readers' Service Item M-5

Premix Polyester Resins

Three new premix Plaskon polyester resins, especially designed for rapid molding of intricate parts having varying wall thicknesses, difficult contours, and molded-in inserts, have been announced by Barrett Division, Allied Chemical & Dye Corp. The new resins, designated PE-40, PE-51, and PE-55, are premixed by the molder in large batches with filler pigment and reinforcing materials, such as chopped glass or sisal compound. This mixture can then be molded in matched metal dies, using conventional compression presses, to give intricate parts at lower cost. The economical premix technique is widely used in the automotive industry.

Each of the three new resins has its own special characteristics. PE-40 is a rigid resin containing diallyl phthalate, and permits fast curing cycles and the production of parts having outstanding surface characteristics, high flexural strength and modulus of elasticity, and excellent hot strength. PE-51, a resilient, high-viscosity resin containing diallyl phthalate, is designed for premix molding applications requiring sufficient flexibility to minimize cracking around core pins and inserts. PE-55 is a resilient, medium-viscosity resin containing vinyl toluene.

Comparative physical properties of the new resins are as follows:

	PE-40	PE-51	PE-55
Barcol hardness	58	45	53
Cure (30 sec. after curing)	38	8	13
Ult. flexural strength, psi.:			
At room temperature	17,900	15,900	16,900
At 200° F.	8,110	5,590	7,380
After 2 hrs. boiling	14,500	10,400	14,500
Modulus of elasticity in flexure, psi. x 10⁶:			
At room temperature	1.6	1.56	1.54
At 200° F.	0.69	0.46	0.52
After 2 hrs. boiling	1.07	1.18	1.17
Ult. tensile strength, psi.	—	3,400	6,120
Water absorption, 24 hrs., %	0.36	0.19	0.149
Pot life of mix at 73° F., days	7	7	8

Readers' Service Item M-6

Phthalate Plasticizer

Diisodecyl phthalate is now available in commercial quantities from the Ohio-Apex Division, Food Machinery & Chemical Corp. The plasticizer was previously made only in experimental quantities by the company. A primary plasticizer for vinyl resins, the material is said to impart permanent flexibility, good low-temperature flexibility, heat and light stability, low migration, low water extraction, and very good hand and drape. Standard tests are said to show less volatile loss than with other widely-used plasticizers, and substantially superior retention of low temperature properties in aging tests.

Specifications reported for the material are as follows:

Specific gravity	0.966
Moisture content, max., %	0.1
Color, APHA	100
Odor	Characteristic
Acidity as acetic acid, %	0.01

Readers' Service Item M-7

VANSTAY
Vanderbilt Materials for Vinyls
VANSTAY C Provides efficient heat stabilization at low cost in tile formulations.
VANSTAY L Recommended for maximum light stability and improved natural ageing in all vinyl resin compositions.
VANSTAY HT–VANSTAY S This combination provides excellent heat protection for vinyl compositions during processing and in service.
VANSTAY N Recommended for use with Vanstay S in non-plating heat stabilizer systems.
VANCIDE 89 Non-metallic fungicide and bactericide effective in vegetable plasticized vinyls.
Our Technical Service Representatives will gladly demonstrate the merits of our materials in your plant and assist in solving production problems.
R. T. Vanderbilt Co., INC. 230 Park Ave. • New York 17, N. Y.

New Equipment

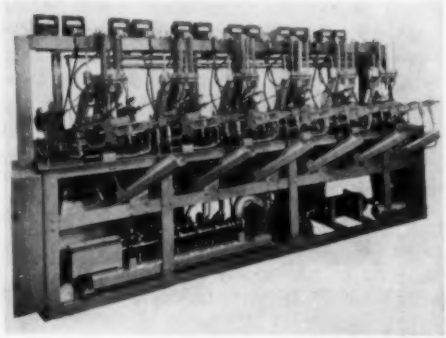
Write item numbers on Readers' Service card to obtain more information.

Three-Shaft Turret Winder

A three-shaft turret winder for continuous in-line production is currently available from Hobbs Mfg. Co. Called the Hobbs-Alquist 3-Shaft Turret Winder, the machine is designed to take a web from a previous continuous process and wind it continuously onto rolls of a predetermined diameter.

This continuous operational feature is said to reduce winding costs, since there is no production loss during change-over. Uniformity of tension eliminates web distortion, thus increasing the sales appeal of the finished rolls. All three of the machine's arbors can be electrically-clutched to the same controlled-tension drive, so that pre-set tension will remain constant at all times regardless of variations in the process speeds.

Rolls up to 36 inches in diameter can be accommodated. Speed change range depends on two factors: diameter build-up and process speed. For example, a diameter build-up from a three-inch core to a 30-inch maximum roll gives a 1:10 ratio, and a process speed of 100-300 feet per minute gives a 1:3 ratio. The combination would give a 1:30 ratio, which is within the 1:36 allowable range.

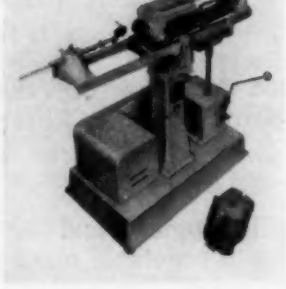


Hobbs-Alquist 3-shaft Turret Winder.

Readers' Service Item E-1

TESTED IS TRUSTED

TO EVALUATE PLASTIC FILM



Scott IP-4 Serigraph*

This exclusive patented Scott Inclined-plane Tester* tests plastic films for tensile, elongation and hysteresis from the thinnest section up to 50 lbs. tensile . . . in conformance with ASTM Specification D882-54T.

REQUEST LITERATURE

*Trademark

SCOTT TESTERS, INC.

149 Blackstone Street, Providence, R. I.

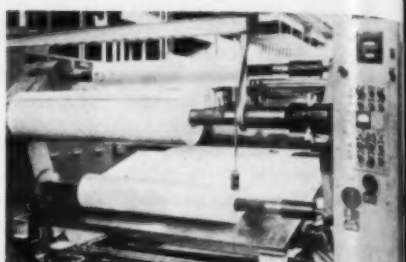
Sheet Forming Machine

The EM-132 Sheet Plastic Forming Machine has been developed by Standard-Knapp Division, Emhart Mfg. Co., for the rapid, automatic production of transparent plastic covers for paper food containers and for other purposes. The plastic lids can be made at speeds up to 72 per minute, and can be formed in either the insert or flush-fill designs.

The machine has a series of six hydraulically-operated forming heads mounted on a common base and controlled by a central timing unit. The heads can be operated singly or as a group. In operation, a stack of transparent plastic discs is placed in a feeding magazine. A vacuum cup removes a single disc at a time from the stack and, at the proper moment, drops the disc into the open mold. After molding under predetermined conditions, the plastic lid is ejected from the opened mold by the action of a knock-out plate and compressed air, and falls into an inclined chute where it is stacked for packing.

The EM-132 will handle disc blanks up to five inches in diameter (adequate for most 16-ounce food containers), and from 7-15 mils in thickness, and is designed to use either split or solid molds. For insert type lids, the lip is formed by the mechanical action of two rings. Flush type lids require use of split molds, because of the greater undercut of the cover.

In addition to the standard unit, the machine can be furnished as a three-head model when high production rates are required. Machine air consumption depends on the shape and size of the covers produced; approximately nine cubic feet per minute of air compressed to 300 psi. is needed for the blowing portion of the machine cycle, and approximately 20 cubic feet of air at 60 psi. pressure is needed for the other operations. Up to 17 kilowatts of electricity (three-phase) is needed, principally for the 7½-hp. hydraulic pump and 10-kw. mold heaters. Since the mold heaters do not operate continuously the average power load is 12-13 kilowatts.



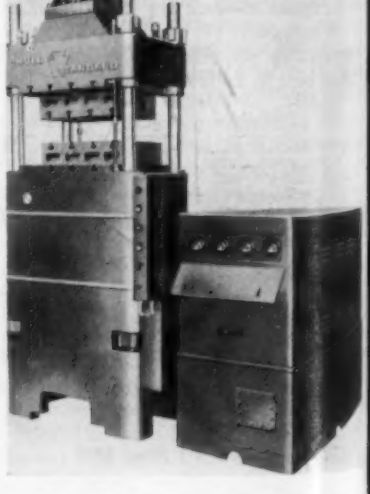
EM-132 Sheet Plastic Forming Machine.

The six-head machine is 269⅝ inches in length, 91 inches high, 46 inches wide and weighs 7,420 pounds. The three-head unit measures 103⅝ inches in length. These dimensions do not include the space occupied by the air compressor (supplied by the customer) or the oil pumping unit; the latter is normally installed near the machine.

Readers' Service Item E-2

Toggle-Type Vertical Press

An improved toggle-type hydraulically actuated press, said to feature a two-second opening and closing time, has been introduced by Hull-Standard Corp. Three models are available: 250-C, for compression molding; 258-C, for transfer molding; and 259-C, for combination transfer and compression molding.



Hull-Standard's toggle-type vertical press.

Self-contained and semi-automatic, the esses have a capacity of 150 tons. The ggle mechanism incorporates larger bear- s and hardened, ground bushings and s which operate in a spray of oil. All ntrols are automatic, except for initiating cycles, and they are accessibly housed a compact power unit. Low hydraulic essure combined with toggle design re- rtedly offer maximum rated capacity th minimum power consumption. This said to permit even alkyds to be molded. The new Quickest sequence-type cycle ntroller gives fingertip press-cycling. ch operation can be dialed individually thout manual compensation. Vernier als, calibrated in minutes and seconds, dicate the time for initial closing, the stance the mold opens for gassing, the eathing period, and the curing cycle. The als may be set independently without ering either their individual effect or e total processing cycle.

Specifications for the two basic models the series are reported as follows:

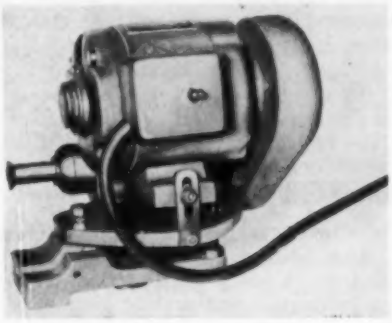
mping pressure, tons, ...	—	150
nsfer capacity, tons	—	25
or space required, in.	77 x 52	80 x 63
ight, in.	107	125
stance between platens, max., in.	37	37
aten dimensions, in.	24 x 23	24 x 23
aten stroke, in.	8	8
pping weight, lbs.	9,400	11,500
wer, hp.	5	10
pacity, oil reservoir, gals.	60	92

Readers' Service Item E-3

Plastic-Threading Machine

A precision machine, which reportedly cuts threads in any plastic material to class-3 tolerance, has been introduced by Gould Machine Tools, Inc. Measuring about 10 inches long by six inches wide, the unit stands eight inches high and is attachable to a lathe or miller.

The thread pitch is established by conventional lathe lead screw, and threads are produced to full depth in one pass after the proper setting has been obtained. The unit can be corrected for helix angle, and will reportedly thread to the shoulder or bottom of the hole within less than one thread pitch. Cutters are easily replaced without loss of center height. Threading is accomplished without chipping, breaking, or fuzzing even difficult materials.



Gould's plastic-thread milling attachment.

Readers' Service Item E-4

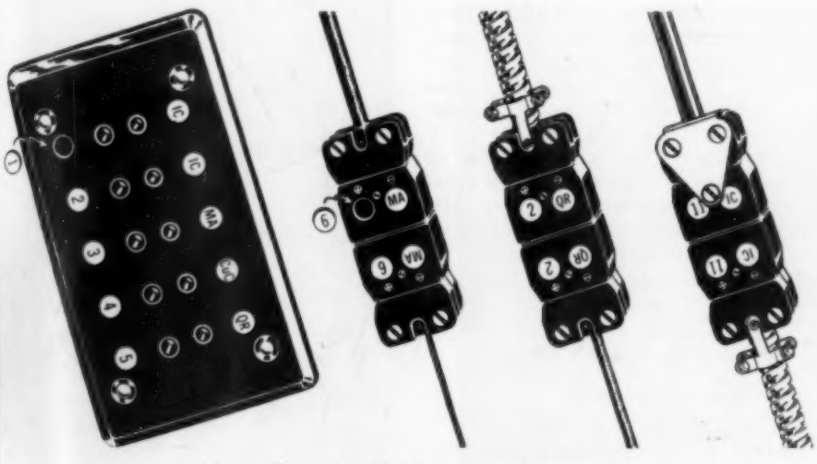
Thermocouple Connector System

Practically any thermocouple connector n be replaced in short order from the ndard interchangeable parts of the Marlin Thermocouple Connector System. roduced by Marlin Mfg. Corp., both mponents and complete assemblies are ailable from stock.

One-piece plug and jack inserts are anufactured in four alloys for various pe thermocouples: iron-constantan, cop- r-constantan, chromel-alumel, and plati- m-platinum-rhodium. All inserts are de- ned for maximum contact area, a unique ring device maintaining high tension at times.

Plug inserts are assembled in a one-piece housing, and are held rigidly in place. A plastic cover protects the thermocouple connection. Center spacing of prong points is said to permit free interchange with other types of thermocouple connectors.

Jack inserts are assembled in a plastic housing, or in a multiple connection panel which accommodates five sets of leads. The Marlin Ident-O discs, etched with numbers or alloy symbols, are tapped into recesses for ease of identification and replacement.



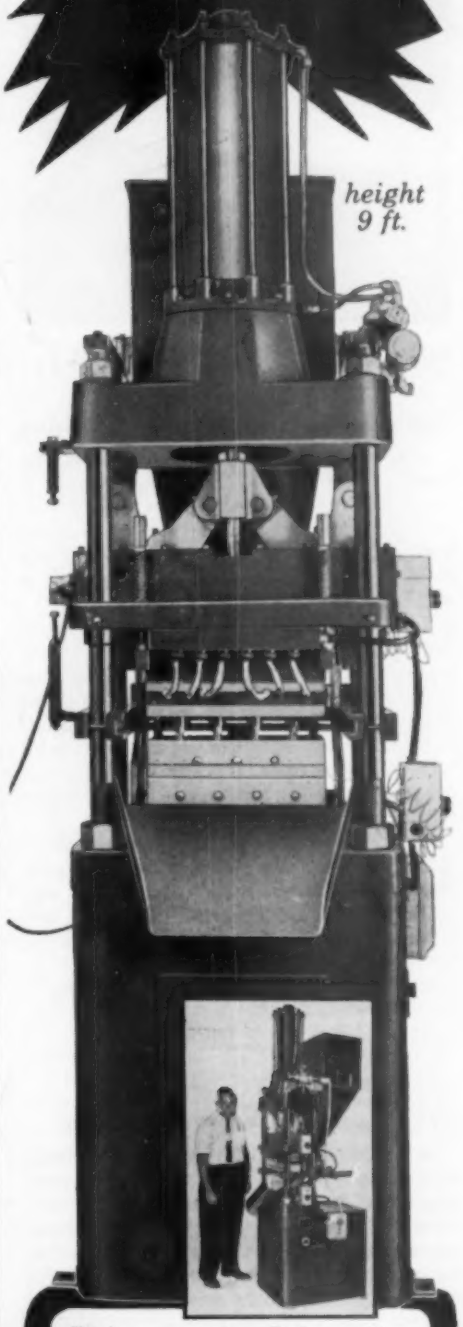
Marlin Thermocouple Connector Systems.

Readers' Service Item E-5

FULLY AUTOMATIC

AUTOMOLD

high speed compression molding machine



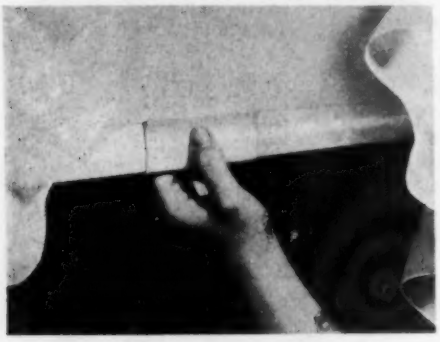
Needs no operator. Cycles continuously. Just adjust to start–refill with raw material as needed–then remove a constant stream of finished products.

Lowest first and maintenance costs. Free counsel on mold design and production. Write for brochure on 25 and 50 ton models. Some territories still open for representatives. Contact

AUTOMATIC MOLDING MACHINE CO.
3217 B Exposition Pl., Los Angeles 18, Calif

New Products

Write item numbers on Readers' Service Card to obtain more information.



Auburn's plastic clip for window shades.

Plastic Clip for Window Shades

A plastic clip that eliminates the dangling tassel or ring-pull of window shades is available from Auburn Button Works, Inc. Injection molded from shatter-resistant high-impact styrene, the clip fits nearly over the hem and slat in the center of a window shade.

Earlier plastic clips of this kind were generally unsatisfactory because of breaking or cracking when placed on the shades, and were made only in harsh, over-brilliant colors. The new clips are made in pastel, natural, and white colors to harmonize with modern color schemes, and do not crack or break even when the jaws are spread wide.

The plastic clips protect shades from soiling and fit firmly in place, yet are easily removed for cleaning and washing. In use, the clips are claimed to be neater and less conspicuous than the old-style shade pulls.

Readers' Service Item P-1

PVC-Insulated Voltage Cable

A 19-conductor #20 Awg. low-voltage cable employing PVC insulation has been developed by General Electric's wire and cable department. Designed for applications not exceeding 30 volts, the cable is said to be particularly suited for remote-control master switches, motor-driven switches, and other complex wiring layouts.

The cable is color-coded for polarity and circuit identification. One white conductor is provided as a common return, with nine red and nine black conductors comprising the circuit pairs. Positive conductor identification is assured by numbering throughout the entire length.

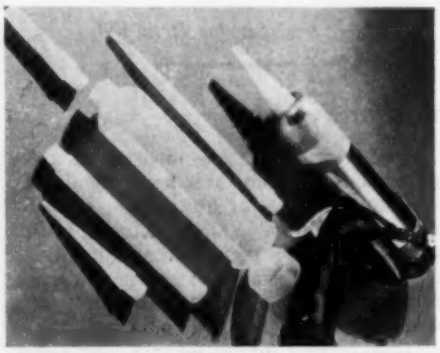
Circuit pairs are cabled adjacent to one another, with a cotton binder over the core, and the assembly covered with a 3/64-inch PVC jacket. Surface printing on the jacket indicates manufacturer's name, number of conductors, size, type, voltage, and SI number.

G-E's 19-conductor low-voltage cable.

Readers' Service Item P-2

Sealant Gun for Assembly Work

Polyethylene finds another application in the disposable cartridges and nozzles molded by Variety Plastics for use in Pyles Industries' new sealant gun. Small, light, and simple to operate, the gun reportedly is well-adapted for a number of caulking jobs in the aircraft, automotive, marine, and electrical fields.



Pyles' sealant gun, with extra polyethylene cartridge and nozzles.

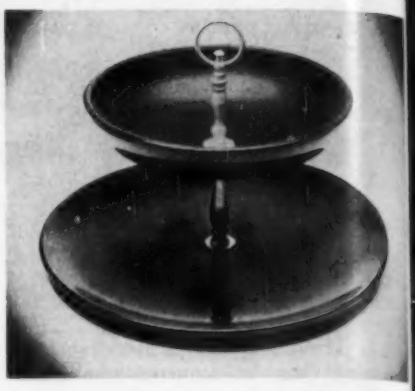
Threaded nozzles, available in a variety of sizes and shapes, screw into the front end of the cartridges. The cartridge, in turn, fits into the gun barrel where air pressure, activated by a press of the trigger, causes the caulking compound to be extruded smoothly and automatically.

The polyethylene cartridges, molded of Eastman Chemical's Tenite, do not react with or affect the properties of commercial caulking compounds. When the supply of sealant is exhausted, they can easily be discarded to eliminate cleaning time and costs.

Readers' Service Item P-3

Melamine Table Accessories

Mission Tableware, a new and colorful line of break-resistant melamine plastic table accessories, is being marketed by Koch Mfg. Co. Molded in Plaskon melamine, a product of Barrett Division, Allied Chemical & Dye Corp., the accessories include twin-level snack and candy serving bars, and a single-tiered Lazy Susan. Available as matching items are a patio platter; salad and bread-and-butter plates; salad, vegetable, baby, and individual serving bowls; and a fruit dish. Handsomely styled, the tableware is available in a wide range of colors.



Two-tier snack bar in Mission Tableware line.

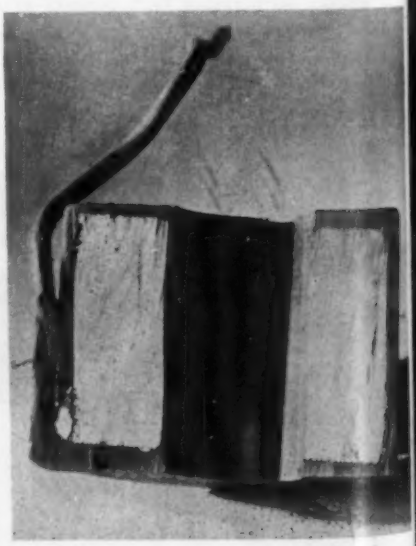
The twin-level snack bars are available with a 10-inch bowl top and either a 12-inch bowl or 14-inch platter bottom. The candy bar has a six-inch plate top and a 7¼-inch plate bottom. The patio platter is 14 inches in diameter, while the salad bowl is 12 inches in diameter.

Readers' Service Item P-4

Molded Coil Windings

Luxolene molded coil windings, a new concept of fabricating waterproof windings for electrical coils, have been announced by DeLuxe Coils. Molded from epoxy resins supplied by Bakelite Co., the coil windings are impervious to water, oils, dust, acids, alkali solutions, and water-based hydraulic fluids.

The windings are completely encased in the resin by incorporating a core tube

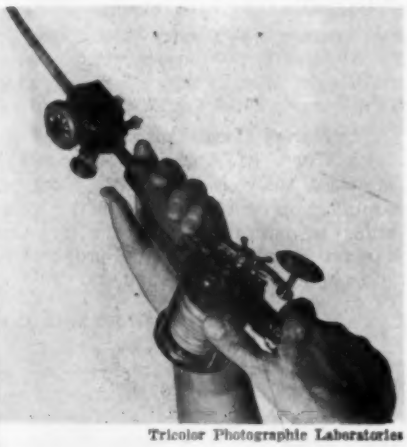


Section of Luxolene coil windings shows complete encasement of coil wires.

made of the same epoxy resin. When cured, this method of fabrication offers a completely homogeneous bond on all external surfaces, and eliminates the difficulty encountered with material separation during thermal cycling when a dissimilar core tube material is used. To provide hermetical sealing of the leads where they emerge from the coils, a chemical bond is attained between the PVC insulation on the leads and the Luxolene resin.

The coil windings are claimed to have a very low shrinkage factor, assuring dimensional stability; a high dielectric strength value of 1,800 volts per mil; and to withstand a 200-megohm leakage test. The windings are being molded in four colors, and are recognized by Underwriters' Laboratories as suitable for general-purpose, class "A" requirements.

Readers' Service Item P-5



Tricolor Photographic Laboratories

Trollmeter uses nylon gear train to measure troll line length.

Troll Line Length Meter

The Trollmeter, made by Production Lathe, Inc., is a lightweight plastic device for indicating bait depth when trolling. The device is easily clamped on any fishing rod; the line looped once around the capstan of the device; and a nylon gear train used to register with great accuracy the length of line paid out. Made of Zytel 101 nylon resin, product of E. I. du Pont de Nemours & Co., the gear train indicates line pay-out in two-foot increments on a dial. The dial registers up to 100 feet and then repeats. Resetting is accomplished by lifting the dial and rotating it back to zero.

In addition to indicating bait depth, the Trollmeter can be used for sounding and measuring any distance that the line can reach. Molds and molded parts for the gears are made by Griffith Tool & Die Co.

Readers' Service Item P-6

Luria-Cournand's Model LTB plastic tote boxes.

Industrial Tote Boxes

A series of new industrial tote boxes molded of rigid rubber-styrene is being offered by Luria-Cournand, Inc. Said to be non-rusting, non-corrosive, and dent-proof, the tote boxes, designated Model LTB, may be compartmented to hold different small parts, and have molded-in ribs on each of the four sides to act as stiffeners and as holders for dividing panels.

The tote boxes are made in four standard sizes, as well as special sizes to order. Standard sizes are eight by eight by six inches (LTB-101), 15 by 12 by 10 inches (LTB-102), 24 by 15 by 12 inches (LTB-103), and 15 by 14 by 5¾ inches (LTB-104). The standard-size units are nestable, and the boxes are made in gray or black, unless otherwise specified.

Readers' Service Item P-7

Inflatable Vinyl World Globe

A world globe made of Bakelite's Krene vinyl plastic is available through C. S. Hammond & Co. Printed in brilliant colors with the latest map information, the globe is inflatable to an 18-inch diameter. Deflated, the globe and wrought iron stand weigh less than two pounds.

Inflatable Krene vinyl globe.

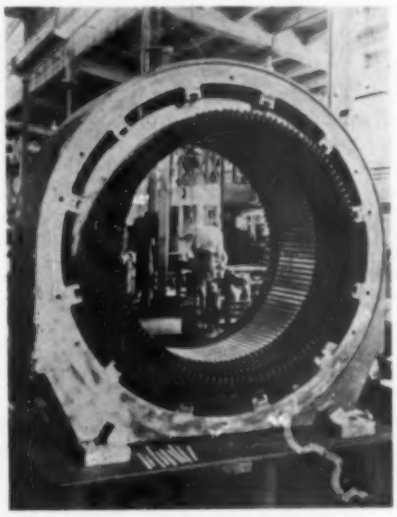
Fourteen pole-to-pole segments are heat-sealed to form the globe. An air valve is inserted at the North Pole for inflation by air pump or lung power. A similar metal socket at the South Pole permits attachment of the stand so that the globe spins freely on its axis at the proper angle.

Flexible and strong, the globe withstands dropping and other rough treatment. Crayon and pencil marks can be removed with a damp cloth, and inherent properties of the material make it impervious to grease, oil, and dirt.

Readers' Service Item P-8

Mica-Filled Epoxy Laminates

A five-fold increase in the service life of traction motors and Banbury mixers is reportedly possible by rewinding coils with a durable laminate of glass cloth and mica-filled plastic based on Bakelite epoxy resin.



Larsen-Hogue's epoxy laminate-rewound coils in 600-hp. motor.

The new coils were developed by Larsen-Hogue Electric Co., with the engineering assistance of Epoxylite Corp., a molding-compound supplier experienced in epoxy potting work.

The new insulation provides a dense seal of dielectric material with none of the voids encountered in conventional coil insulation. This keeps out dirt, carbon black, and metal dust which build up deposits, and in a relatively short time grounds the electricity and shorts out the motor. Not only is the laminate impervious to moisture and most chemicals, but it forms a permanent bond to the copper conductor upon application of heat and pressure.

Field tests showed the compounds to be especially effective on railway traction armatures. Other potential fields of application include petroleum pumping, sewage disposal, and mining equipment, where moisture, contamination, and vibration impose difficult working conditions.

Readers' Service Item P-9

New Literature

Write item numbers on Readers' Service card to obtain copies of literature.

"Survey of Cachalot Brand Fatty Alcohols." M. Michel & Co. 12 pages. The company's line of straight-chain aliphatic alcohols is described, including over 100 applications (in the plastics and other industries) for Cachalot 12- to 18-carbon alcohols as intermediates and additives. Typical reactions, infra-red spectra, and solubility charts are included.

Readers' Service Item L-1

"Elastex 20-A Plasticizer." Technical Data Report C-5513. Barrett Division, Allied Chemical & Dye Corp. Typical physical and chemical properties, solubility data, and formulation test data are given for the plasticizer, a diisodecyl adipate. The material is said to impart excellent low temperature properties to vinyls, combined with low volatility and good resistance to head degradation.

Readers' Service Item L-2

"Products of Union Carbide & Carbon Corporation." Union Carbide & Carbon Corp. 12 pages. This is a classified list of the products made by the company and its principal divisions and subsidiaries. A listing of these divisions and subsidiaries is included, together with the location of their general and sales offices.

Readers' Service Item L-3

Publications of National Aniline Division, Allied Chemical & Dye Corp.:

"Adipic Acid." Technical Bulletin L-12. 8 pages. The six basic reactions of adipic acid's carboxyl groups and the 11 basic reactions of the alpha-methylene group are discussed along with suggested applications.

Readers' Service Item L-4

"Epsilon-Caprolactam." Technical Bulletin I-14. 10 pages. Physical properties, chemical reactivity, and applications for this polymerizable material are covered in this brochure. A vapor pressure curve and an infrared absorption spectrogram are included.

Readers' Service Item L-5

"Nacconates." Technical Bulletin I-17. 24 pages. Diisocyanates are discussed as a class including generic properties, data on 27 basic reactions common to the group, and suggested applications for each of the firm's five diisocyanate materials.

Readers' Service Item L-6

"Nacconates 80, 65, 100, 200, and 300." Technical Bulletins I-17A through I-17E. 20 pages. This series of five separate four-page brochures treat each diisocyanate material individually. Physical properties and an infrared spectrogram are given for each product, in addition to composition data.

Readers' Service Item L-7

Publications of Injection Molders Supply Co.:

"Catalog of IMS Nozzles for All Injection Machines." 46 pages. Photographs and diagrams of stock and special nozzles are included, together with specifications and prices. Identification and indexing is by machine type, and accessory equipment and lubricating compounds are described.

Readers' Service Item L-8

"IMS Catalog of Injection Molding Plant Equipment." 65 pages. This 1956 edition includes specifications, prices, and photographs of IMS grinders, materials handling equipment, drum tumblers, drying ovens, mold releases, nozzles, cylinders, and accessories. It supercedes all previous issues.

Readers' Service Item L-9

"IMS Special Advance Engineering Data Sheets." 4 pages. These sheets cover specifications and prices for a special nylon drying oven, test nozzle sets, one-piece HPM replacement nozzles, and Haskins nozzle seat lappers.

Readers' Service Item L-10

"The New IMS M-400." 4 pages. This brochure covers specifications and prices for the M-400 two-stage, 11 x 17 throat, high-output granulator.

Readers' Service Item L-11

"Crezon Gives Plywood a Charmed Life." Crown Zellerbach Corp. 4 pages. Physical properties, and applications for Crezon, a plywood made from phenolic resins and cellulose fibers, are listed in this illustrated bulletin.

Readers' Service Item L-12

"Wood with a Charmed Life." Crown Zellerbach Corp. 8 pages. Properties and applications of Crezon plywood are depicted in a series of captioned photographs.

Readers' Service Item L-13

"Polyacrylamide." New Product Bulletin No. 34. American Cyanamid Co. 19 pages. PAM 75 is a stable, neutral, and water-soluble polymer which will undergo hydrolysis, imidization, methylolation, chlorination, hydrogeneolysis, and the Hoffman reaction. Potential applications include use in adhesive formulations, leather, paper and surface coatings, thickening agents, and as a molding compound when condensed with formaldehyde. Physical property charts are included.

Readers' Service Item L-14

"Engineers Handbook & Catalog." Mycalex Corp. of America. 24 pages. The Mycalex story is presented, along with complete property data on the various grades of natural and synthetic mica. Comparison figures, illustrations, design criteria, and applications are included.

Readers' Service Item L-15

"Acrylic Esters." F-7434. Carbide & Carbon Chemicals Co. 8 pages. Physical and chemical properties, methods of polymerization, reactions, and applications are described in this bulletin. Acrylic esters are very reactive monomers used in the manufacture of adhesives, protective coatings, and plasticizers.

Readers' Service Item L-16

"Houghton Serves the Plastics Industry." E. F. Houghton & Co. 4 pages. This bulletin describes the firm's oils, greases, and gum solvents which are used in hydraulic and lubrication systems. A complete line of "V" and "U" packings are offered, as well as a personalized engineering service.

Readers' Service Item L-17

"Mobay—the Urethane Story." Monsanto Chemical Co. 20 pages. The background of Mobay Chemical Co., and polyurethane is given in this well illustrated brochure. Processing and applications are covered in some detail.

Readers' Service Item L-18

Book Reviews

"Metal Finishing Guidebook." Finishing Publications, Inc., 381 Broadway, Westwood, N. J. Fabricoid, 5¼ by 8 inches, 606 pages. Price, $3.50.

This is the 1956 edition of a directory devoted exclusively to metallic surface treatments The major editorial content consists of contributed articles covering such general topics as finishing plant engineering, mechanical surface preparation, plating solutions and procedures, and control and testing. Numerous tables and data sheets are included, along with a directory of suppliers, and a listing of trade names, consultants, professional societies, and schools of electroplating.

An article on the "Plating of Plastics" covers the metallization of plastics by the chemical reduction, mirror-spray, and metal evaporation methods. Procedures and techniques are described, and a survey of possible new methods also is given. Bibliographies are included at the end of each article.

"Cellulose and Cellulose Derivatives, Part III." Edited by Emil Ott, Harold M. Spurlin, and Mildred W. Grafflin. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6 by 9 inches, 553 pages. Price, $12.00.

This is the third and concluding part of the book on cellulose, Volume V in the publisher's series on High Polymers. Of the preceding sections, Part I covered the occurrence of cellulose; the chemical nature of cellulose and its derivatives; the structures and properties of cellulose fibers; and the properties of substances associated with cellulose in nature. Part II covered the preparation of cellulose from natural sources; the bleaching and purification of wood cellulose; the properties and treatment of pulp for paper; and the derivatives of cellulose.

This book consists of three major chapters and a set of appendices, all contributed by outstanding authorities in the field, and both author and subject indexes. The chapters cover the physical properties of cellulose and its derivatives in solution; the mechanical properties of cellulose and its derivatives; and tests for cellulose and its derivatives. The appendexes include tables on properties of commercial chemical cellulose; substitution relationships; viscosity curves and tables; solubility of cellulose derivatives; properties of cellulose derivatives; trade and generic names; and definitions and constants. The author and subject indexes cover all three parts of the volume.

The comprehensive nature of this work is self-evident, and the compilation presents an exhaustive, up-to-date discussion of the entire field of cellulosics.

"Rubber Red Book, 1955-56 Edition." Published by "Rubber Age," 101 West 31st St., New York 1, N. Y. Cloth, 6 by 9 inches, 1,249 pages (including advertisements). Price, $10.00.

This new edition of the Red Book, the tenth, reflects the continuing growth of the rubber manufacturing industry in the United States and Canada. As such, it gives data on 1,410 rubber manufacturers operating a total of 1,635 factories. In addition to providing directory material on the domestic rubber industry, much information is included on vinyl, polyethylene, and other plastics, especially those made or sold by firms in the rubber industry.

As in previous editions, the directory provides information on rubber manufacturers in the United States; rubber manufacturers in Canada; rubber machinery and equipment; laboratory and testing equipment; accessories and fittings; rubber chemicals and compounding materials; fabrics and textiles; natural rubber and related materials; synthetic rubber; reclaimed rubber; scrap rubber and plastics; latex and related materials; miscellaneous products and services; consulting technologists; sales agents and branch offices; export agents; educational courses in rubber chemistry and technology; trade and technical organizations; technical journals; who's who in the rubber industry; and a subject index.

"The Modern Building Encyclopedia." Edited by N. W. Kay. Published by Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. Cloth, 6 by 9 inches, 768 pages. Price, $15.00.

More than 30 experts have contributed to this new and comprehensive reference work planned to meet the needs of the building industry and its allied trades. Designed to cover the requirements of everyone interested in building, the volume contains nearly 4,000 alphabetical entries that offer a complete and up-to-date guide to all terms used in the theory and practice of present-day building techniques. In many cases, these entries are not just definitions, but consist of broad introductions to subjects such as architecture, plastics, and prefabrication, and detailed descriptions of such operation as arch construction, plastering, and chaining.

Of special interest are the descriptions of the tools used in various crafts and occupations in the building industry, such as brick laying, concrete and asphalt work, and plumbing. The special applications of mathematics, chemistry, and mechanics in the field also are covered in an authoritative manner. All entries are cross-referenced for easy and rapid use, and more than 800 special line drawings are included.

"Quote . . . Unquote"

Importance of National Standards

"We do not have an adequate set of well-conceived national standards. Our progress in standards has lagged behind our advance in other areas of the national economy. Many companies today actually are not practicing what was learned about standards work in the 1920's. Some companies are indifferent to the national standards program, despite the fact that they profit from it daily in everything they buy and use. They are letting the work be done and the bill be paid by those enlightened and growing companies who lead their industries and who recognize the program to be a common responsibility.

"Despite this lag, tremendous progress has been made in standards work in recent years, and the promise for the future is even greater. The federal government, for example, has made a historic change for the better in policy in accepting industry standards wherever practical instead of writing its own. Standards engineers are taking their place on executive planning boards of more and more companies.

"It is being more widely recognized that basic standards work that is not done early in the life of new industries and technologies will have to be done later at a terribly increased cost in materials, manpower, dollars, and time.

"ASA has recently approved its 1,500th American Standard. That is exactly double the number of American Standards in existence only eight years ago. Each of these standards is clear, concrete evidence that business has acted to remedy an unsatisfactory condition, to cure an industrial ill, to improve its efficiency, to regulate itself in the public interest.

"There has been a great resurgence of national standards activities in the past few years. An excellent base has been laid on which American industry and its great trade associations and technical societies can build the much larger complex of integrated national standards that the economy must have to prosper, expand, and raise our American Standard of living."

H. T. Hallowell
Pres., American Standards Association
Pres., Standard Pressed Steel Co.,
Jenkintown, Pa.

• • •

Outlook for Vinyls

"The markets for vinyls for which the greatest growth is anticipated are various surface coating applications, wire coating, flooring, and coated fabrics. Film suffered a severe setback during the past few years, but the next five will show growth."

Gordon Brown, Vice President,
Bakelite Co., Division of
Union Carbide & Carbon Corp.,
New York, N.Y.

Abstracts of Important Articles

Materials

"X-Rays in the Study of Plastics," E. Frasson, *Materie Plastiche*, 21, 10, 827 (Oct. 1955).

Knowledge of the molecular structure of plastic fibers and the crystallinity of a fiber is of considerable practical importance for determining possible application. The author discusses the examination of natural and synthetic fibers by means of X-ray diffraction and what this reveals about the way in which properties are affected by orientation. In a concluding note, mention is made of the value of X-ray diffractions in studying the composition and crystallinity of plastics materials and in investigating swelling phenomena. (In Italian).

"Precipitated Calcium Carbonate as a Filler for PVC," H. M. Macturk and I. Phillips, *Brit. Plastics*, 28, 11, 463 (Nov. 1955).

Precipitated calcium carbonate offers various advantages when used as a filler in PVC. The method of producing precipitated calcium carbonate from calcium chloride and sodium carbonate, and also from calcium hydroxide and sodium carbonate or carbon dioxide, is mentioned and the properties of various coated and uncoated types that are commercially available are listed. The methods of incorporation and the effects of four grades (Calofort S, Calofil A.4, Sturcal L.S., and Sturcal L) on PVC compounds are discussed and critically compared.

"Stability Characteristics of some High Polymers," K. Richard and G. Diedrich, *Kunststoffe*, 45, 10, 429 (Oct. 1955).

The importance of long-term stability tests on load-carrying structural parts made from plastics is explained, with reference to polytrifluorochloroethylene and polyethylene. Such tests (1) permit the determination of the effect of cold flow on stability under static load; (2) yield values for time/extensibility and time/stability limits required for dimensioning structural parts; (3) reveal the effect of form on stability and the effect of surrounding fluid on extension, and (4) in the case of polytrifluorochloroethylene, the tendency to form stress cracks. Experiments on polyethylene test rods are compared with the behavior of internally-stressed tubes, and permissible stress values are given. Instruments used for the load test and for measuring extensibility are described. Since the tests are costly, a scheme of joint research by all interested groups is suggested. (In German).

"Permeability of Polyester Resins to Ultraviolet Light," J. Voigt, *Plaste u. Kautschuk*, 2, 9, 200 (Sept. 1955).

Comparative studies indicated that ultraviolet permeability of linear polycondensation products of maleic acid and bifunctional alcohols is a very simple process independent of molecular weight and determined only by the concentration of maleic acid residues. Solutions of free maleic acid of the same concentration show considerable similarity in the permeability process. In this respect, chloroform solutions of resins hardly differ from films of the resins. The limits of short-wave permeability changes relatively little when part of the maleic acid residues are replaced by adipic or phthalic acid residues. The range of selective light absorption for unsaturated maleic resins is below 340 mu, so that this wave-length zone must be held responsible for the often-described photochemical changes in these substances. Since natural sunlight contains ultra-violet rays down to 290 mu, the effect of sunlight on linear polyesters is obvious. The maleic acid residue is the point of attack for the decomposing effect of light and the author suggests that the primary break probably consists in excitation of the carbon double bond, which is already strongly activated by conjugation with the CO groups, after which oxidative cleavage or polymerization of the double bonds is possible. This photolytically-initiated decomposition reaction is to be further investigated. (In German).

"Investigations of the Permeability of Plastics to Ultraviolet Light," H. Bauer, *Plaste u. Kautschuk*, 2, 9, 197 (Sept. 1955).

Hitherto, comparatively little has been said in the literature about the permeability of plastics to light. The author mentions the various factors influencing permeability oxydative and hydrolytic processes, addition of compounding ingredients, monomer content, polymerization process, etc., and explains the formulae and methods developed for measuring permeability. He makes use of the relation of the light intensities, as expressed by the dark areas they cause on a photographic plate. Measurements were undertaken on PVC, acrylics, polyethylene, benzyl cellulose, cellulose triacetate, and cellulose butyrate. Surprisingly enough, the effect of various plasticizers was found to be better permeability with increased content. (In German).

"Investigation by Stress Optics—an Aid to Technologists," H. Pohl and S. Altrichter, *Plaste u. Kautschuk*, 2, 9, 207 (Sept. 1955).

The possibilities of stress optics are considered and the principles and methods are explained, as well as the requirements which manufacturers of plastics suitable for such work must meet when supplying investigators with model materials. (In German).

"The Physical Properties of 'Teflon' Polytetrafluoroethylene," R. C. Doban, C. A. Speruti, and B. W. Sandt, *SPE J.*, 11, 9, 17 (Nov. 1955).

A detailed discussion of the properties of Teflon which are shown to be a consequence of its true fluorocarbon structure.

Equipment

"Direct Current Porosity Tester for Plastics," W. Becker, *Kunststoffe*, 45, 10, 461, (Oct. 1955).

Instruments with induction coils to generate high-frequency alternating current have hitherto been used to detect faults in plastic linings. Although operators are largely protected by the use of cable with vulcanized screening, the danger of accidental contact with the brushes remains. The author describes a new instrument to test plastics for porosity which works with high-tension current and is claimed to practically eliminate this disadvantage. (In German).

"Practical Experience with the Ko-Kneader," J. Aeschbach, *Kunststoffe*, 45, 10, 456, (Oct. 1955).

After discussing the improvements made in the Ko-Kneader and its attachments, such as the automatic feed hopper, temperature controller, and four types of granulators, the author reports on experiences in processing plastics with this machine, stressing in a concluding paragraph that its field of application is limited to that of mixing, kneading, and plasticizing. (In German).

"Mold Design for Injection Molding Machines," H. Gastrow, *Kunststoffe*, 45, 45, 493 (Oct. 1955).

Discussion of designs with edge sprue and chamber sprue. (In German).

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines will be printed here quarterly. The next complete listing will appear in March.

—The Editor

"New Rewind Apparatus for Blown and Calendered Film," W. Schmitt, *Kunststoffe*, 45, 10, 453 (Oct. 1955).

Two types of take-off and rewind apparatus, designed to be connected to the machine actually producing blown or calendered film, are discussed which appear to take into account the stress conditions in the material. In the first, for blown film, squeeze rolls and spread, cutting, and wind-up devices are all combined in one unit. The second, still in an experimental stage, has a tiltable frame designed to accommodate two, three, or four rewind rolls for calendered sheet, and is equipped with feed and cutting units. (In German).

"Applications of Glassed Steel in Processing," J. M. Culotta, *Plastics World*, 13, 11, 4 (Nov. 1955).

Glassed steel has reportedly proved effective as an equipment lining for the processing of such plastic materials as polystyrene, PVA, PVC, polyesters, polyurethanes, and a variety of plasticizers. Temperature and pressure limits, processing advantages, processing problems, and polymerization vessel capacities are discussed.

Processing

"Polyester Resins in Cold Molding of Reinforced Plastics," U. Monaco, *Materie Plastiche*, 21, 10, 833, (Oct. 1955).

In Italy, the polyester used for the above purpose is Montecatini's Gabropoliestere. After taking up the compounding of the resins, the author successively treats hand forming, vacuum molding, rubber bag molding, and molding in autoclave with a rubber skin, as applied to various articles including automobiles, boats, mannikins (made in three sections), and artificial arms. Finally, finishing methods are discussed. (In Italian).

"Experiences in Extruding Plastic Pipe," G. Schenkel, *Kunststoffe*, 45, 10, 486 (Oct. 1955).

The processes and plants presently used for extruding accurately dimensioned plastic pipe are discussed and critically compared. A new method of centering and calibration is described, and the possibilities of continuous control of dimensions considered. (In German.)

"Processing Technique for Polyvinyl Carbazol," H.-R. Jacobi, *Kunststoffe*, 45, 10, 481 (Oct. 1955).

In Germany, the Badische Anilin & Soda Fabrik A.G. produces polyvinyl carbazol, known as Luvican M 170, in three forms: transparent block material; material with a fibrous structure; and granules. The properties of these materials and the appropriate methods of processing them are discussed, the differences with the related polystyrene being particularly stressed. It is pointed out that because of the higher working temperature required by polycarbazol, it frequently cannot be processed on the same machines as polystyrene. (In German.)

"Technical Considerations on Vacuum Forming," G. Matulat and H. Picht, *Kunststoffe*, 45, 10, 484 (Oct. 1955).

The various sources of possible mistakes in vacuum forming are mentioned, including the installation of machines, storage of material, pre-heating, and choice of mold materials. Attention is called to a new two-mold process for large moldings that is now being developed. (In German.)

"Drying Hygroscopic Plastics," H. Haas, *Kunststoffe*, 45, 10, 435 (Oct. 1955).

Taking polyamides and cellulose acetate as examples of markedly hygroscopic plastics, the author describes the sorption mechanism via the solvation of free polar residues, and the capillary condensation dependent on the partial pressure of water vapor in the air. The moisture absorbed by these hygroscopic plastics interferes with such further processing as melt-spinning of polymerized caprolactam, covering polyethylene-insulated wires with very thin polyamide sheathing, and injection molding of acetate to such an extent that preliminary drying is necessary. The theoretical possibilities and practical procedures in ordinary and high vacuum drying are discussed. (In German.)

"Process and Plant for Producing Composite Plastic Materials," W. Nehmiz, *Kunststoffe*, 45, 10, 434 (Oct. 1955).

Methods and machines for combining PVC and polyethylene sheet with another plastic sheet or a sheet of textile material, paper, or metal are briefly described, as well as properties and applications of the resulting composite materials. (In German.)

Applications

"Methods of Testing Modified Polystyrenes for Use in Telephone Housings," Hilding Hogberg, *Modern Plastics*, 33, 3, 150 (Nov. 1955).

Four styrene polymers were tested for impact strength, strength of weld lines, water absorption, scratch resistance, and insulating properties. Comparison tables are given, along with a discussion of requirements for molded telephone housings.

"Plastics for Foundry Work," R. Walter, *Kunststoffe*, 45, 10, 451 (Oct. 1955).

Brief mention is first made of the resins used as binders in making compact sand molds and cores for casting metal parts. The main portion of the article discusses in detail the production of a shell mold by the J. Croning process. The author notes that the problem of accelerating the disintegration of the resin binder in the case of an aluminum casting (where the casting temperature is low) has been solved recently by the use of phenol-Novolak-Hexa resins to which a disintegration accelerator is added, when disintegration is twice as fast at 600° as with normal Novolak-Hexa resins. (In German).

"Vinyl Plus Reinforced Plastics," F. W. Reynolds and L. N. Chellis, *Modern Plastics*, 33, 4, 115 (Dec. 1955).

The problems inherent in forming a vinyl sheeting-reinforced plastics laminate for business machine housings are discussed; including part design, vinyl-fabric overlay, resin formulation, molding techniques, resin formulas, dies, and finishing operations.

"Development of Reinforced Plastics Pressure Vessels for Chemical Corps Applications," Milton A. Raun, *Modern Plastics*, 33, 4, 146 (Dec. 1955).

Fibrous glass-reinforced polyester pressure vessels were tested for burst strength, volumetric expansion and permanent set under pressure, material fatigue, etc. Probable causes of failures were noted, along with certain general conclusions as to the materials' value in construction.

"Tools from Plastics," K. Meyerhans, *Kunststoffe*, 45, 10, 443 (Oct. 1955).

There is a growing interest in the use of plastics for tools (as models, patterns, dies, etc.) for the airplane, automobile, electrical, and, in general, the metal-consuming industries. The development of this application in the United States and Europe is discussed, particularly for the epoxy resins which have gained a clear preference for this purpose over cellulose derivatives, phenolics, and polyester resins because of their special properties. Methods of employing the epoxy resins are described in detail, and their advantages and disadvantages are mentioned. Close cooperation between consumers and producers is expected to lead to a satisfactory solution of remaining problems. (In German).

General

"Plastics Engineers—When?", Lloyd A. Chacey, *SPE J.*, 11, 8, 25 (Oct. 1955).

The majority of states give registration as professional engineer only, usually by an individual qualifying in his chosen branch if it be recognized in that state. Recognition of plastics as a branch of engineering will undoubtedly depend on the issuance of a degree in plastics by an accredited engineering college. To achieve recognition and promote unity, it is suggested that those who can, make every effort to join the National Society of Professional Engineers.

"Numerical Values Expressing the Properties of Materials, Particularly of Plastics," P. Dubois, *Ind. Plastiques Mod.*, 7, 9, 33 (Nov. 1955).

In this lecture, which was delivered at the III Journees Internationales des Matieres Plastiques, held in Paris in March 1955, the Director of the Research Center for Plastics, Paris, reviews the latest work carried out at the Center on the numerical determination of material characteristics, at the same time announcing the specific points covered and apparatus described in papers presented at this conference by investigators at the Center. (In French).

Patent Digest

Materials

Organosiloxane Elastomers Containing Boron Compounds. No. 2,721,857. Norbert G. Dickman, Midland, Mich. (to Dow Corning Corp., Midland, Mich.).

The composition consists essentially of an organopolysiloxane of the general formula $R_nSiO_{4-n}/2$ and 0.005-0.09 parts by weight of a boron compound.

Spray-Drying Process for Making Plastisol Grade Vinyl Chloride Polymers. No. 2,721,859. Albert W. Fuhrman, Naugatuck, Conn. (to United States Rubber Co., New York, N. Y.).

Vinyl chloride resin latices are spray-dried separately at different temperatures within the range of 200-550° F. The dried materials are then finely ground to a particle size of 5-15 microns, and mixed.

Oxyalkylated Derivatives of Fusible Acetylene-Phenolic Resins. No. 2,723,250. Melvin De Groote, St. Louis, and Bernhard Keiser, Webster Groves, Mo. (to Petrolite Corp., Wilmington, Del.).

Hydrophilic synthetic products are obtained by reacting ethylene oxide and alpha, beta-propylene oxide with an oxyalkylation-susceptible, fusible phenolic resin which is soluble only in an organic solvent.

Thermo-Settable Intermediate Condensation Products. No. 2,723,253. James W. Wandell, Bronx, N. Y.

This urea-formaldehyde is made by adding urea to an aqueous syrupy urea-formaldehyde condensation mass in which a filler has been incorporated. The final molecular ratio of formaldehyde to urea should be 1¼-1½:1, at which point the resultant mixture is heated at a temperature of 270-300° F. for a short period of time.

Polymeric Materials and Method for the Manufacture Thereof. No. 2,723,968. John C. Williams, St. Charles, Ill. (to Hawley Products Co., St. Charles, Ill.).

One molar portion of a vinyl chloride, singly unsaturated, and capable of self-polymerization, is copolymerized with a 0.03-0.23 molar portion of a doubly-unsaturated organic compound in the presence of an oxygen-supplying catalyst and an inert solvent. The resultant copolymer is vulcanized with rubber compounding ingredients, including sulfur, to form a thermoelastic material.

Polymeric Phosphates of Copolymers of Acyclic Ethylenically Unsaturated Epoxy-Free Monomers and Ethylenically Unsaturated Epoxy Monomers. No. 2,723,971. Martin E. Cupery, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

The polymeric phosphates should have a phosphate content of at least 1.75% by weight, and be the reaction products of a polymeric epoxide copolymer having a molecular weight of at least 1,500. Phosphoric acid should be present in a concentration of at least ½-mole per oxirane oxygen atom, and epoxide oxygen content should range from 0.3-8% by weight. The polymerized, ethylenically - unsaturated epoxy monomer accounts for 3-60% by weight of the final product; and the polymerized acyclic ethylenically-unsaturated epoxy-free monomer accounts for 40-97%.

High-Melting Polymers of Para-Tert-Butylstyrene. No. 2,723,261. Irving E. Levine, Albany, Calif., and William E. Elwell, Scarsdale, N. Y. (to California Research Corp., San Francisco, Calif.).

This new thermoplastic material is a polymeric para-tert-butylstyrene, which has an average molecular weight of 50,000 and a heat distortion temperature of 120-130° C.

Polymerized Acrylonitrile Compositions. No. 2,723,258. John A. Price, Stamford, Conn. (to American Cyanamid Co., New York, N. Y.).

The copolymer comprises, by weight, 69.75 parts acrylonitrile; 3.75 parts methyl acrylate; and 1.5 parts of allylpyridinium chloride.

Modified Polyester Resin. No. 2,724,705. Robert S. Glover, Jr., Huntington Woods, Mich. (to Hercules Powder Co., Wilmington, Del.).

The polymerizable composition comprises 30-70% unsaturated polyester of a polyhydric alcohol and a polycarboxylic acid, 30-70% of an ethylenically-unsaturated monomer, and 1-40% of a pine-wood resin which is substantially insoluble in petroleum hydrocarbons.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.
—The Editor

Vinyl Resin Compositions Comprising a Polyvalent Metal Salt of an Acid Containing a Thioether Group. No. 2,723,965. William E. Leistner, Brooklyn, Arthur C. Hecker, Richmond Hill, and Olga H. Knoepke, Brooklyn, N. Y.

The composition comprises a vinyl chloride resin and a stabilizer of the general formula R-S-Y-COOMe; in which R represents a monovalent hydrocarbon group containing 1-18 carbon atoms, Y an alkylene group containing 1-5 carbon atoms, and Me a metal such as barium, strontium, calcium, magnesium, cadmium, lead, zinc, or tin.

Preparation of 1,1-Difluoro-1,2,2-Trichloroethane. No. 2,724,004. Marvin E. Frederick, Wadsworth, O. (to B. F. Goodrich Co., Akron, O.).

Tetrachloroethylene is reacted with an excess of hydrogen fluoride under pressure, and in the presence of 2-15% antimony pentachloride, heating the reaction mixture to 100-250° C.

Method of Dimerizing Vinylidene Chloride. No. 2,724,005. Thomas Houtman, Jr., Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Monomeric vinylidene chloride and catalytic amounts of aluminum chloride are mixed and subjected to temperatures below 0° C. for several hours. The aluminum chloride is removed, the reaction mixture is subjected to distillation, and 2,4,4,4-tetrachloro-1-butene is recovered.

Process of Preparing Vinyl Chloride. No. 2,724,006. Hans Krekeler, Konigstein, Germany, (to Hoechst Aktiengesellschaft vormals Meister Lucius & Bruning, Frankfurt am Main-Hochst, Germany).

In this method, vinyl chloride is prepared by the thermal decomposition of 1,2-dichloroethane. Pressure between 20 and 30 atmospheres is applied, and distillation carried out at a temperature of 450-650° C.

Equipment

Temperature Control Apparatus. No. 2,722,716. George E. Henning, Baltimore, Md. (to Western Electric Co., Inc., New York, N. Y.).

Temperature of plastic material within an extruder is controlled by means of a stock screw, which has a longitudinal bore. The bore is open at the entrance end portion of the screw, closed at the delivery end. Cooling fluid is introduced; the rate being controlled by a thermocouple which is located in the bore, near the delivery end.

Method and Apparatus for Making Reinforced Plastic Laminates. No. 2,723,705. Howard W. Collins, Newark, O. (to Owens-Corning Fiberglas Corp., Toledo, O.).

Fibers of reinforcing material are grouped around a mandrel, with the fibers extending longitudinally. Other reinforcing

fibers are spirally wound to anchor the first fibers, at which point the resinous binding agent is added. Other equipment required include spools for winding the glass fiber warps, a means for advancing the mandrel, winding means, and a system for applying resin, pressure, and heat.

Manufacture of Reinforced Plastic Tubing. No. 2,723,426. Perry H. Pelley, Wichita, Kans. (to Beech Aircraft Corp., Wichita, Kans.).

A device for the manufacture of plastic tubing consists of a mandrel having a rigid central hollow form, and a tube of expansible material. The latter fits closely to the form, thereby providing a firm support around which the plastic sheet is wrapped. The tube is expansible away from the hollow form, which has openings to admit expanding fluid. A separable mold chamber receives the mandrel, and a heating element cures the plastic material.

Apparatus for the Manufacture of Patterned Thermoplastic Strip Material. No. 2,723,424. Julius Veit, Hounslow West, England. (to Duratube & Wire, Ltd., Middlesex, England).

The apparatus comprises an extrusion die with an elongated, horizontal extrusion orifice. A straight, obstructing element, longer than the orifice length, is affixed horizontally in front of the orifice at a predetermined distance. This element obstructs the normal free flow of the thermoplastic strip material, causing it to form protuberances at regular intervals.

Injection Molding Machines. No. 2,724,146. Samuel Charles Henry Smith, West Ewell, England. (to R. H. Windsor, Ltd., London, England).

The unit consists of an injection cylinder; a reciprocating injection plunger; injection nozzle; a tapering, cylindrical plasticizing chamber; a spreader disposed within the chamber; a plurality of radially extending ribs, which define the forwardly-tapering conical cavity; slots which permit the outward flow of plasticized material; and a heating means extending the entire length of the chamber.

Extrusion Apparatus. No. 2,723,028. Irwin M. Carter, Frankfort, Ind. (to Aluminum Co. of America, Pittsburgh, Pa.).

The extrusion die structure comprises a die plate having a plurality of die apertures formed in circumferential arrangement around the geometric center of the die plate. A pedestal is attached centrally, movable into and out of the sealing assembly. The discharge end is in longitudinal axial alignment with the extrusion cylinder axis. Cantilever arms extend radially from the pedestal, each terminating in a rearwardly-directed mandrel. Free terminal ends of the mandrels project into a registering die aperture to define the die orifice.

Apparatus for Making Void-Free Fabric Laminates. No. 2,722,962. William J. Hampshire, Cuyahoga Falls, James C. Coomes, Suffield, and Roy A. Motz, Greentown, O. (to Goodyear Aircraft Corp., Akron, O.).

Cup-shaped, multi-curved, resin-impregnated fabric laminates are produced with an apparatus consisting of a male and female mold, a separate bleeder cloth, an impervious flexible cover sheet, means for spacing the mold members, means for introducing fluid pressure between the cover sheets, and separate means for evacuating between each laminate and its cover sheet.

Plastometer. No. 2,722,832. Harald R. Rasmussen, Rumford, R. I. (to Scott Testers, Inc., Providence, R. I.).

The plastometer has a hollow stator for receiving the specimen, a rotor, a rotatable shaft having an axial bore, and a detachable bushing. The shank-portion of the rotor is non-circular in cross section, and fits the axial opening, thereby securing it for drive. Specimens pass from the stator, past the shank, and through the bore.

Processing

Process for Making Wall Covering. No. 2,725,324. Floyd A. Holes, Solon, O. (to The Dobeckmun Co., Cleveland, O.).

Decorative fabric wall coverings are produced from the following materials: a backing sheet of paper; a dimensionally-unstable fabric sheet; a nitrocellulose adhesive, plasticized with castor oil and thinned with isopropyl acetate; and a vinyl acetate or chloride film, in which dioctyl phthalate has been added as a plasticizer, and barium and cadmium ricinoleate were used as stabilizers. The adhesive is reactivated and, on hardening of the film, the fabric wall covering is stripped from the paper backing.

Laminated Article Containing Resinous Impregnation Compositions. No. 2,725,321. Norman E. Martello, Turtle Creek, Pa. (to Westinghouse Electric Corp., East Pittsburgh, Pa.).

The composition comprises an A-stage emulsified phenolic resin, which is the potentially thermosettable reaction product of a phenol and a formaldehyde, mixed with a suspending agent such as cellulose, casein, or gum tragacanth. Sodium or calcium lignin sulphonate is added to solubilize the dispersing agent, and a mineral such as aluminum oxide or silicon carbide, is suspended therein.

Protected Adhesive Plastic Sheet Material and Methods of Making the Same. No. 2,725,325. Malcolm Seymour, North Andover, Mass. (to B. B. Chemical Co., Boston, Mass.).

An adhesive copolymer of vinyl acetate and vinyl chloride, which also contains butadiene or acrylonitrile, is deposited in a uniform film on a sheet of paper. On drying, a thin sheet of ester-plasticized vinyl copolymer is moistened with a volatile organic solvent and pressed against the adhesive film. A permanent union is brought about through the action of the plasticizer.

Method and Apparatus for Casing Vinyl Film Continuously. No. 2,723,962. William D. Hedges and John C. Lowman, Franklin County, O. (to Columbus Coated Fabrics Corp., Columbus, O.).

Textile sheets are impregnated with a resin composition composed of the following constituents: 10 parts vinyl acetate or chloride copolymer; 3 parts titanium dioxide; 4 parts powdered clay; 2 parts linear polyester of 1,2 propylene glycol and sebasic acid; 4 parts dioctyl phthalate; 0.2 parts tetrahydrofurfuryloleate; 0.3 parts dibasic lead stearate; and 0.1 parts paraffin wax.

Applications

Synthetic Resin Insulated Electric Circuit Element. No. 2,725,312. John W. Schell, Erie, Pa. (to Erie Resistor Corp., Erie, Pa.).

The circuit element has a moisture-proof coating comprising a base coat layer of polymerized monochlorotrifluoroethylene, and a cover coat of water-free silicone varnish. The silicone is polymerized in situ, the under coat being protected by interposing a small amount of a non-ionic higher alcohol.

Ornamental Plastic Object. No. 2,724,919. Ewald Leyendecker, Long Island City, N. Y.

A cast body of clear plastic, having convex obverse and reverse faces, are carved cameo fashion to simulate precious stones. Convolute, opaque films, imbedded in the plastic, defines the design and cause it to show an intaglio effect when viewed from certain angles.

Wax Applicator. No. 2,723,411. Alfred F. Ellis, Roseland, N. J.

The applicator consists of a transparent plastic tank; a synthetic sponge portion of differential-flow properties, so arranged that the tank feeds through the sponge rather than laterally; a hollow, transparent handle in free communication with the tank; and a means for adjusting the flow of fluid onto the sponge.

Shoe Having a Polyethylene Counter. No. 2,723,468. Robert J. Marcy, New York, N. Y. (to Endicott Johnson Corp., Endicott, N. Y.).

A flexible polyethylene shoe counter is included in the heel, covered by a strip of leather. An adhesive coating on the polyethylene causes it to adhere, yet permits easy replacement of the surface leather on deformation. Since the adhesive used on the polyethylene is permanently tacky, and therefore reusable.

Domestic Production and Sales of Plastics and Resin Material, September and October, 1955

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of March and April, 1955. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Over-all picture shows little change other than what might be expected due to Fall business. Styrenes, vinyls, and polyethylenes showed the greatest increases.

	September		October	
Cellulose Plastics:[1]	Production	Sales	Production	Sales
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,885,671	1,824,280	1,659,842	1,718,955
Sheets, 0.003 gage and over	1,422,689	1,366,088	1,508,321	1,525,509
All other sheets, rods, and tubes	703,351	755,538	711,619	665,928
Molding and extrusion materials	8,728,142	8,852,976	8,373,816	8,130,545
Nitrocellulose sheets, rods, and tubes	395,830	394,766	415,240	428,007
Other cellulose plastics	429,521	439,780	384,727	433,674
TOTAL	13,565,204	13,633,428	13,053,565	12,902,618
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	18,166,954	16,465,362	19,469,839	18,049,178
Bonding and adhesive resins for—				
Laminating (except plywood)	5,823,224	4,723,104	6,356,997	4,723,738
Coated and bonded abrasives	1,370,881	1,468,037	1,429,789	1,434,465
Friction materials (brake linings, clutch facings, and similar materials)	2,230,367	1,992,004	2,238,093	1,797,646
Thermal insulation (fiber glass, rock wool)	5,171,730	5,316,570	5,191,523	5,067,218
Plywood	3,857,249	3,407,927	3,669,924	3,018,721
All other bonding and adhesive uses	2,334,632	2,381,168	3,050,264	2,545,135
Protective-coating resins, unmodified and modified except by rosin	2,481,274	2,196,678	2,462,926	2,054,933
Resins for all other uses	3,266,411	2,594,720	3,212,845	2,300,398
TOTAL	44,702,722	40,545,570	47,082,200	40,991,432
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,410,196	3,467,489	3,914,990	3,956,618
Paper-treating and paper-coating resins	1,965,747	2,104,952	2,462,635	2,162,067
Bonding and adhesive resins for—				
Plywood	9,031,452	8,395,640	8,579,538	8,349,510
All other bonding and adhesive uses, including laminating	2,727,023	2,322,257	2,896,102	2,590,039
Protective-coating resins, straight and modified	3,258,472	3,038,263	3,436,995	2,885,855
Resins for all other uses, including molding	7,146,022	7,725,939	8,572,810	7,704,891
TOTAL	27,538,912	27,054,540	29,863,070	27,648,980
Styrene Resins:				
Molding materials[1]	35,057,204	31,893,789	40,179,800	38,050,603
Protective-coating resins, straight and modified	8,022,658	7,613,842	8,637,627	7,830,293
Resins for all other uses	15,246,994	8,299,659	16,977,606	8,017,724
TOTAL	58,326,856	47,807,290	65,795,033	53,898,620
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for—				
Film (resin content)		6,982,807		7,498,482
Sheeting (resin content)		4,166,209		4,580,654
Molding and extrusion (resin content)		15,412,328		16,064,421
Textile and paper treating and coating (resin content)[3]		5,582,234		6,043,032
Flooring (resin content)		4,707,365		5,456,551
Protective coatings (resin content)		2,313,374		2,172,415
All other uses (resin content)		4,016,903		4,485,425
All other vinyl resins for—				
Adhesives (resin content)		3,071,897		2,669,976
All other uses (resin content)		9,128,676		9,835,889
TOTAL	60,967,888	55,381,793	62,159,385	58,806,845
Coumarone-Indene and Petroleum Polymer Resins	23,599,090	23,748,913	23,471,156	22,971,739
Polyester Resins:				
For reinforced plastics	3,803,282	4,010,947	3,630,604	3,312,141
For all other uses	289,239	188,338	231,194	100,948
TOTAL	4,092,521	4,199,285	3,861,798	3,413,089
Polyethylene Resins	37,214,859	30,613,517	39,208,150	34,616,537
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1] [4]	4,541,205	4,243,482	4,857,554	4,443,228
Protective-coating resins[5]	381,485	233,562	351,711	194,076
Resins for all other uses[6]	6,873,682	6,476,407	8,025,279	7,326,799
TOTAL	11,796,372	10,953,451	13,234,544	11,964,103
GRAND TOTALS	281,804,424	253,937,787	297,728,901	267,213,963

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
SOURCE: United States Tariff Commission, Chemical Division.

Current Market Prices

Price Changes and Additions

Adhesives

Synvaren PLS-A	lb.	.56 /	.595
Synvarol WR-513	lb.	.1875/	.1225
WR-515	lb.	.0825/	.1175

Coating Resins

Ladcote FHHF-4010, FYHF-4010	lb.	.3575/	.4075
Synvaren 631	lb.	.175 /	.25
PLS-R	lb.	.765 /	.80
Synvarite BRLD	lb.	.40 /	.45

Colors

Aquablak No. 1	lb.	.1925/	.1975
B	lb.	.0975/	.1025
G, K	lb.	.12 /	.125
H	lb.	.20 /	.205
L	lb.	.14 /	.145
M	lb.	.105 /	.1
S	lb.	.1175/	.1225
U	lb.	.225 /	.23
X	lb.	.11 /	.115
Coloidex No. 3	lb.	.24	
Columbian Carbon bone blacks:			
Ivo No. 1	lb.	.1975/	.2075
3	lb.	.1875/	.1975
4	lb.	.16 /	.17
100	lb.	.2075/	.2175
359	lb.	.2025/	.2125
457	lb.	.1925/	.2025
Columbian Carbon colloidal dispersions:			
Coacetateblak CQ-21	lb.	.875 /	.90
CoblacDD Sol, Industrial	lb.	.70 /	.725
Coethloblak CK	lb.	1.00 /	1.025
Coresinblak No. 3	lb.	.76 /	.785
Costyreneblak CJ-21	lb.	.5425/	.5675
Covarnishblak AR	lb.	.60 /	.625
BJ	lb.	.50 /	.525
BK	lb.	.53 /	.555
Covinylblak BA	lb.	.95 /	.975
BD	lb.	.97 /	.995
BF	lb.	.70 /	.725
BH	lb.	.66 /	.685
BL	lb.	.82 /	.845
BM	lb.	.77 /	.795
CA-18	lb.	1.0725/	1.0975
Cowaxblak BV-25	lb.	.515 /	.54
CB-18	lb.	.5875/	.6125
CM-83	lb.	.485 /	.51
DC Globak	lb.	.77 /	.795
DCV Coblac	lb.	.83 /	.855
Hiblak AE	lb.	.095 /	.10
Mapico colors, black	lb.	.1425/	.145
Browns	lb.	.1525/	.155
Reds	lb.	.1375/	.14
Tans	lb.	.2275/	.23
Yellows	lb.	.115 /	.1225
RBH pulverized pigment dispersions:			
Blacks	lb.	.70 /	.75
Blues, iron	lb.	.865	
Phthalocyanines	lb.	2.71	
Browns	lb.	.595 /	.835
Greens, chrome	lb.	.845	
Phthalocyanines	lb.	2.32	
Orange	lb.	.86	
Purple	lb.	2.95	
Red	lb.	1.92	
Whites	lb.	.69 /	.72
Yellow	lb.	.80	
Resin plasticizer pastes:			
Blacks	lb.	.50 /	.63
Blue	lb.	1.58	
Green	lb.	1.57	
Orange	lb.	.655	
Reds	lb.	1.14 /	1.99
White	lb.	.48	
Yellows, cadmium	lb.	1.18	
Chrome	lb.	.535	
Iron oxide	lb.	.48	
V nyl extrusion chips:			
Blacks	lb.	.935 /	1.01
Blues, iron	lb.	.90 /	1.075
Phthalocyanine	lb.	2.50	
Brown	lb.	.86	
Green, chrome	lb.	.96	
Oranges	lb.	.875 /	.92
Purple	lb.	3.41	
Reds	lb.	1.38 /	2.02
White	lb.	.76	
Yellow	lb.	.845	

Fillers

Atomite	ton	32.50
Burgess Iceberg Pigment	ton	50.00
Pigment No. 30	ton	37.00
Crown Clay	ton	14.00
Duramite	ton	20.00
Kaolloid	ton	10.50
Secco Clay	ton	12.00
Sno-Brite Clay	ton	12.50
Snowflake	ton	20.00

Lubricants

Advawax 280	lb.	.365 /	.39
HSC #35	lb.	1.28 /	1.34

Plasticizers

Columbian Carbon butyl stearate	lb.	.2275/	.3125
Capryl alcohol	lb.	.195 /	.295
Caprylene	lb.	.06 /	.16
Dibenzyl sebacate	lb.	.88 /	.965
Dibutyl phthalate, dihexyl phthalate	lb.	.30 /	.39
Dibutyl sebacate, CP	lb.	.64 /	.725
Dicapryl adipate, dihexyl adipate	lb.	.42 /	.51
Dicapryl phthalate	lb.	.295 /	.38
Dicapryl sebacate, dioctyl sebacate	lb.	.58 /	.665
Dihexyl sebacate	lb.	.62 /	.705
Diisooctyl phthalate, dioctyl phthalate	lb.	.305 /	.395
Dimethyl sebacate	lb.	1.25 /	1.335
Harchemex	lb.	.24 /	.34
Harflex 300	lb.	.58 /	.67
500	lb.	.315 /	.405
Methyl hexyl ketone	lb.	.26 /	.36
Sebacic acid, CP	lb.	.67 /	.79
Purified	lb.	.59 /	.71
Darex DIBA	lb.	.4325/	.4625
DIBM	lb.	.32 /	.3475
DIBP	lb.	.30 /	.33
DIDA, DIOA	lb.	.425 /	.455
DIDP, DIOP, DOP, DOP-HR, IOIDP	lb.	.305 /	.335
Harchem Division's Harflex Series:			
10	lb.	1.25 /	1.335
40	lb.	.64 /	.725
50, 80	lb.	.58 /	.665
60	lb.	.62 /	.705
90	lb.	.88 /	.965
120, 150	lb.	.305 /	.395
140, 160	lb.	.30 /	.39
180	lb.	.295 /	.38
220, 250	lb.	.425 /	.515
260, 280	lb.	.42 /	.51
300	lb.	.58 /	.67
500	lb.	.315 /	.405
Harchem butyl stearate	lb.	.2275/	.3125
Sebacic acid, CP	lb.	.67 /	.79
Purified	lb.	.59 /	.71
R C Plasticizers:			
B-17	lb.	.21 /	.33
BD-8	lb.	.38 /	.50
BIDP	lb.	.27 /	.42
DBP	lb.	.30 /	.44
DIDA, DIOA, DOA	lb.	.425 /	.56
DIDP, DIOP, DOP, ODP	lb.	.305 /	.45
DIOS, DOS	lb.	.58 /	.71
O-16	lb.	.275 /	.395
TG-8	lb.	.31 /	.43
TG-9	lb.	.41 /	.53

Resins & Molding Compounds

Polyester

Acme 1-501	lb.	.82 /	.93
1-501A	lb.	.87 /	.98
1-503	lb.	2.75 /	3.50
1-510	lb.	.89 /	1.00
Thermaflow 100, 200, 300	lb.	.48 /	.82
400, 500	lb.	.52 /	.87
1,000, 2,300	lb.	.34 /	.55
2,400	lb.	.36 /	.58

Styrenes

Darex Copolymer 3	lb.	.47 /	.67
43G	lb.	.39 /	.58
X34	lb.	.42 /	.61
Latices 3L	lb.	.415 /	.56
610L	lb.	.30 /	.46
3020	lb.	.32 /	.47

Urea

Sylplast molding cmpds., granules	lb.	.33	
Powder	lb.	.30	

Vinyls

Pliovic AO (dispersion)	lb.	.30 /	.32
DB80V, DB90V, EDB90V	lb.	.27 /	.29

Stabilizers

Advastab 17-M	lb.	2.95 /	3.00
21	lb.	1.00 /	1.05
23-30, 23-74, 23-147, BA-13-P, BC-105	lb.	.75 /	.80
30-6, L paste	lb.	.65 /	.70
48-79, 143, C-77	lb.	.85 /	.90
50-671	lb.	2.65 /	2.70
50-I.T, T-72	lb.	3.20 /	3.25
52, OM-10	lb.	1.90 /	1.95
89-X	lb.	.70 /	.75
BC-12, E-82	lb.	.90 /	.95
CH-20, E-49	lb.	.55 /	.60
E-98	lb.	.53 /	.58
JCX	lb.	.62 /	.67
OM-18	lb.	3.10 /	3.15
SN	lb.	.47 /	.52

CALENDAR of COMING EVENTS

February 20
SPE Southern Section, Mammy's Shanty, Atlanta, Ga.

March 1
SPE Southern California Section, Scully's Restaurant, Los Angeles, Calif.

March 7
SPE Western New England Section, Bradley Field, Windsor Locks, Conn.

March 12
SPE Cleveland-Akron Section, Spanish Tavern, Brecksville, O.

March 14
SPE Newark Section, Military Park Hotel, Newark, N. J.

March 15
SPE Ontario Section, St. Regis Hotel, Toronto, Ont.

March 15
T5D Committee, National Association of Corrosion Engineers, Hotel Statler, New York, N. Y.

March 19
SPE Upper Midwest Section, Worwa's Cafe, Minneapolis, Minn.

March 21
SPE New York Section, Gotham Hotel, New York City.

March 28
Reinforced Plastics Group, SPE New York Section, Tufaro's Restaurant, Corona, N. Y.

March 28
SPE Quebec Section, Queens Hotel, Montreal, Que.

March 28
SPE Philadelphia Section, Franklin Institute, Philadelphia, Pa.

April 12
Fort Wayne Rubber & Plastics Group, Van Orman Hotel, Fort Wayne, Ind.

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Monsanto Chemical Co., St. Louis, Mo., has announced that its organic chemicals division's plant in Texas City, Tex., for the production of tertiary-butylamine is scheduled for completion this month, and expected to begin operations in January. The plant, said to be the first commercial-size facility in the country to make tertiary-butylamine, represents a major move by Monsanto into the aliphatic amine field.

Ray-O-Lite Corp. of America, San Diego, Calif., has opened a new western division office in El Monte, Calif. Robert J. Considine has been named manager of the division.

Positions Open

Display Rates $10.00 per Inch.

REINFORCED PLASTICS DEVELOPMENT AND RESEARCH

An engineer or chemist is required to undertake laboratory and field investigations in the application of polyester resins. This is an unusual opportunity for a well trained technical man. Send full particulars to Hooker Electrochemical Company, Industrial Relations Department, Niagara Falls, New York.

PLASTICS TECHNOLOGIST

Opportunity in San Francisco Bay Area for a chemist or chemical engineer with 3 to 6 years experience in the compounding and application of thermosetting resins and other polymers. Research involves the evaluation of new materials and the development of their uses. Please write giving personal and work history to:

Shell Development Company
Emeryville 8, California

SALES ENGINEER wanted by well established plastic fabricator; main plant situated in southeastern Ohio. This is an excellent opportunity with a progressive company. Send resume with full details; strict confidence. Reply to Box No. 52

PLASTICS TECHNOLOGY
386 FOURTH AVENUE, NEW YORK 16, N.Y.